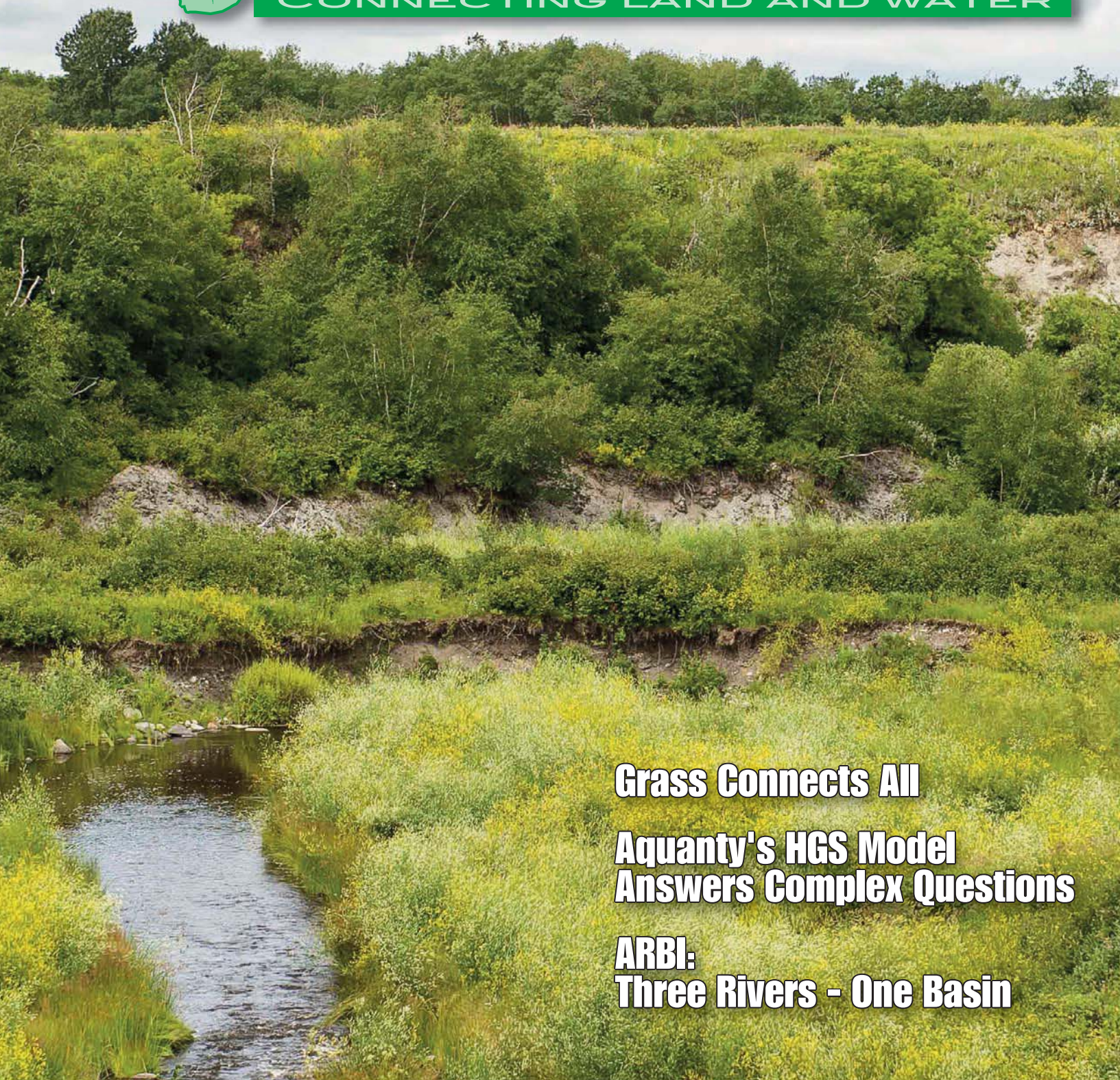
FALL 2016

Manitoba forage & grassland Association

MFGA Aquanty Project's

# the grasslander

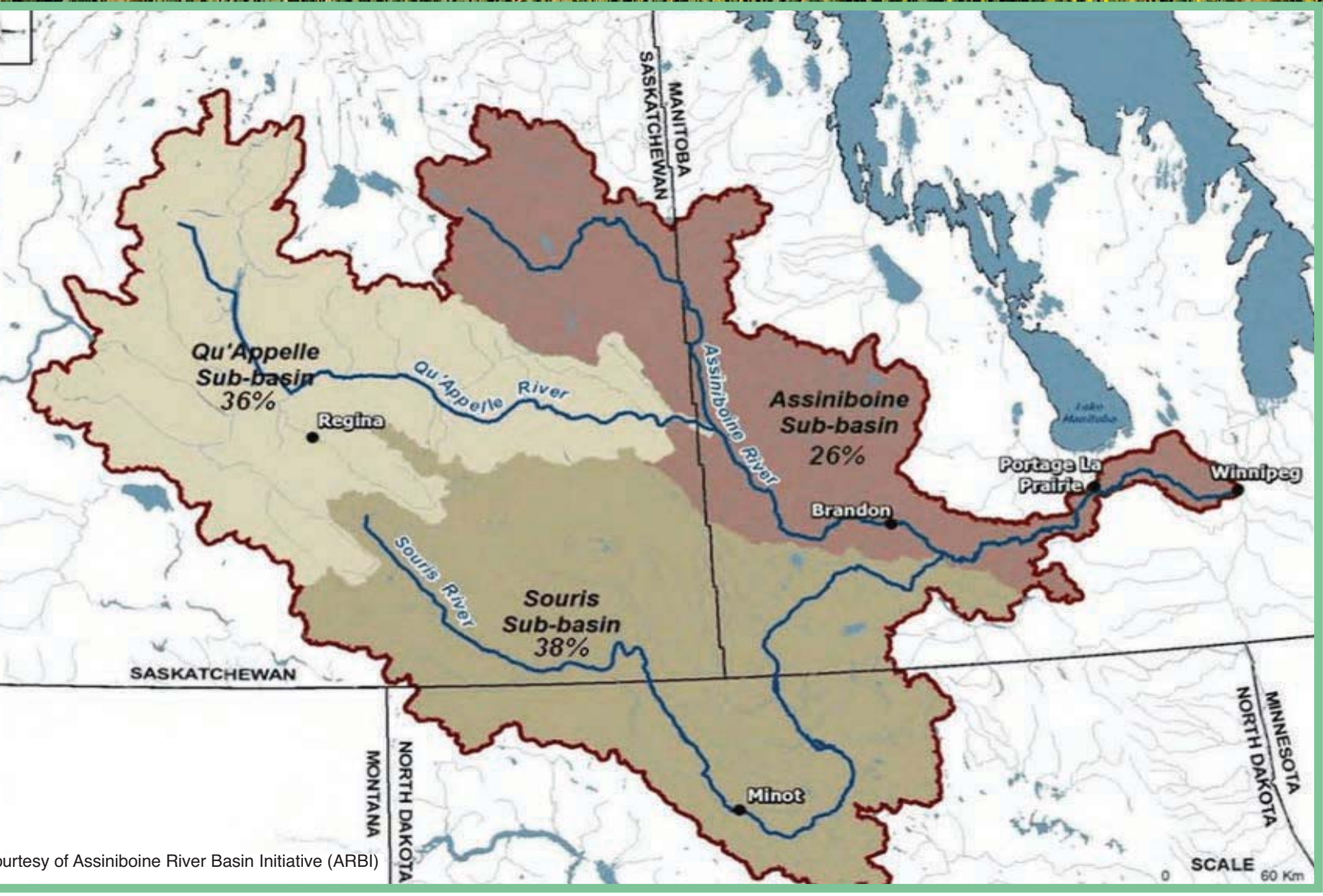
CONNECTING LAND AND WATER



## Grass Connects All

## Aquanty's HGS Model Answers Complex Questions

## ARBI: Three Rivers - One Basin




Courtesy of Assiniboine River Basin Initiative (ARBI)

**Funding for the MFGA Aquanty Project was secured by the Canada and Manitoba governments through *Growing Forward 2*, a federal-provincial-territorial initiative.**

Growing Forward 2
A federal-provincial-territorial initiative

Manitoba

Canada

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All Photos 'D²', D. Derlago, c/o MFGA Aquanty Project

## from the editor

We have all seen the highly visible impacts of flood and drought events. We're all familiar with images of water-covered saturated fields and devastated urban areas, the resulting shoreline erosion of waterways and the dry, drought-cracked beds of dried-up water sources. Across the Assiniboine River Basin (ARB), flood and drought have been regular occurrences. In fact, as Natalia Klumper explores on page 8 of this magazine, flood and drought are regular parts of life in the basin. And this is expected to continue, perhaps accelerate, in times ahead.

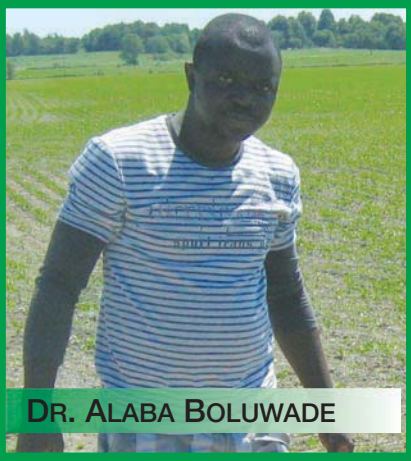
With agriculture as the dominant land use and economic driver of the ARB, it is understandable that leaders at AgriRisk Initiatives, Agriculture and Agri-Food Canada, would want to examine risk and risk reduction and support projects that address the needs of the insurance industry by providing better risk assessment tools for the times of flood and drought ahead. Add in the valuable support of the Province of Manitoba and the project's steering committee groups, and that, essentially, is how the Manitoba Forage and Grassland Association's (MFGA) Aquanty project came to reality for the ARB. The MFGA Aquanty project's HydroGeoSphere (HGS) model will look at the basin in detail that has never been done before. Once completed, the model will have tremendous value for numerous stakeholders while at the same time providing strong insurance and risk endpoints for the project funders. As one example, in times of drought and flood, getting cattle to food or food to cattle comes at increased financial costs. The model will look at the role of forages and grasslands in potentially reducing risk and promoting better land use planning.

As the project management team, we created this magazine to help us communicate the values of this excellent project to the many stakeholders across the ARB and beyond. We want to inform and motivate all key audiences to support, understand and utilize the MFGA Aquanty project HGS model. We believe this magazine will help us all understand the great things this model may realize and help us all get behind the MFGA Aquanty project's potential for the Assiniboine River Basin.

Please enjoy.
Duncan Morrison, Editor
Executive Director, MFGA

# Hay Bales...

## DR. ALABA BOLUWADE'S IN FOR MFGA AQUANTY PROJECT



DR. ALABA BOLUWADE

Aquanty, along with ISM Canada in Regina (a subsidiary of IBM), is part of a project that is being led by the Manitoba Forage and Grassland Association (MFGA) to construct a web-based hydrologic modelling platform for the Assiniboine River Basin.

A key component of the project involves using Aquanty's Hydro-GeoSphere (HGS) modelling software for the hydrologic analysis, and IBM high-performance computing resources and predictive analytics software to generate decision support information for multiple stakeholders. On this front, Steven Frey, MFGA Aquanty project lead scientist, is pleased to announce the hiring of Alaba Boluwade, who holds a PhD from McGill University and has completed postdoctoral research in the Department of Civil Engineering at the University of Manitoba. Dr. Boluwade is taking a one-year residency at the Aquanty offices in Waterloo before moving to Brandon University, where he will engage with project stakeholders while continuing to work with Aquanty and the HGS modelling platform.

"The actual modelling platform will be developed under the MFGA project," says Frey. "However, there is considerable opportunity to conduct additional science-driven research with the platform through the investigation of land-use change, climate change and land drainage impacts on the hydrologic characteristics of the Assiniboine River Basin."

Because Dr. Boluwade's research interests with the HGS platform align closely with those of the agricultural sector, funding for his position was secured by the Canada and Manitoba governments through Growing Forward 2, a federal-provincial-territorial initiative.
"We were privileged to have the support in bringing this position to reality," says Frey. "It is very exciting for the entire project team to be able to add Dr. Boluwade's considerable expertise to the project."

## WATER GETS ACADEMIC ATTENTION

BRANDON UNIVERSITY ASSINIBOINE COMMUNITY COLLEGE

Brandon's two post-secondary institutions are watching the Manitoba Forage and Grassland Association's (MFGA) Aquanty project closely with an eye on the future and, especially, what that future might hold for their students.
"Brandon University is ideally situated with our Master's program for the MFGA Aquanty project model," says Dr. Pete Whittington, assistant professor in Brandon University's Geography Department. "The hydrology of the Assiniboine River Basin and how we manage our water resources are great tie-ins with the model for our students."
Assiniboine Community College's Steve Hills agrees. "Water resources, policy and management are all important to the local economy and the environment," says Hills, a Geographic Information Systems instructor at Assiniboine Community College (ACC). "This will give resource managers, municipalities, researchers and others an enhanced tool to understand the impact of water movement."
Whittington and Hills sit on the project's steering committee. They say the impact of flood and drought events on the Wheat City and the Assiniboine River Basin make the model a natural bridge into their respective study areas.
"Students in our program are constantly challenged to bring process-based decision-making to complex hydrologic scenarios as part of the curriculum and the MFGA Aquanty project model presents many scenarios that will easily fit that required area," says Whittington.
Hills sees many benefits from the model for ACC students and specifically points to the "2+2" program combining Land and Water Environmental Technologies and Management, shared by ACC and BU, on environmental monitoring and management in an agricultural context.
"There is a lot of opportunity on those fronts as well as networking, research and lectures that can arise from the MFGA Aquanty project for our Land and Water programs," Hills says.

# and Waterways

## ISM Canada develops user-friendly web-based systems for MFGA Aquanty project

Travis Juffinger

The advanced technology of Aquanty Inc.'s HydroGeoSphere (HGS) hydrologic simulation software facilitates physically complex simulations of water movement through surface water and groundwater flow systems.

However, the question of how the specialized information will be shared with stakeholders is one of the key aspects of the MFGA Aquanty project, because the direct interpretation of HGS data output has been a task traditionally reserved for academic researchers and scientists.

To that end, ISM Canada, an IBM company collaborating on the project, will develop a web-based data analytics system (based on the Cognos platform) to interpret the output from the HGS model for the Assiniboine River Basin (ARB) and its major sub-basins, and will provide user-friendly interfaces for multiple stakeholders to interact with the HGS output.

"We're playing a key role in a project that will help to understand and reduce the impact of extreme floods and droughts on agricultural activities within the Assiniboine River Basin," says Travis Juffinger, ISM Application Consultant and lead on the project. "ISM is developing a web–based data analytics system and is building application programming interfaces (APIs) in order to ingest a wide variety of different data into the HGS simulation platform with the ultimate goal of being able to provide a user-friendly decision support tool to a range of different stakeholders."

Juffinger is particularly keen on the work he is doing developing the dashboards and story maps for the end users of the project.

"Hydrologic issues have far-reaching effects, often spanning multiple industries. A single emergency event can have implications on regional flooding, water and soil contamination, insurance claims and future land use," says Juffinger. "It is highly engaging to play a part in the recognition of these problems, as well as providing meaningful solutions and recommendations to the various project stakeholders. The project's potential for saved time, money and lives in the future is certainly a motivating factor for the entire team."

## MFGA Aquanty Project Backgrounder

Funding for the MFGA's Aquanty project is chiefly provided by an Agriculture and Agri-Food Canada (AAFC) AgriRisk Initiatives (ARI) Program – Research and Development Stream funding commitment of $1,145,800 and Manitoba Agriculture's commitment of $180,000 to the two-year project. The remainder of the $1,732,300 total project funding will be provided by partners and supporters via a combination of in-kind and cash contributions.

**Term of the Project:** March 1, 2016 to March 31, 2018

**Applicant/Recipient:** Manitoba Forage and Grassland Association (MFGA)

**Primary Funder/Program:** Agriculture and Agri-Food Canada (AAFC), Growing Forward 2, AgriRisk Initiative

**Secondary Funding Partner:** Manitoba Agriculture, Growing Forward 2, federal-provincial-territorial initiative

**Key Partner:** The Assiniboine River Basin Initiative (ARBI)

**Core Contractors:**

1. Aquanty Inc.: Aquanty Inc.'s core technology is the HydroGeoSphere (HGS) hydrologic simulation software. Aquanty Inc. uses a range of high-performance computing resources to run physically complex simulations of water movement through surface water and groundwater flow systems.
2. ISM/IBM: ISM, sub-contracted to Aquanty Inc., will develop a web-based data analytics system (based on the Cognos platform) to interpret the output from the HGS model for the ARB and its major sub-basins, and will provide user-friendly interfaces for multiple stakeholders to interact with the HGS output.

**Steering Committee:**

- Keystone Agricultural Producers (KAP)
- Agricultural Producers Association of Saskatchewan (APAS)
- Manitoba Beef Producers (MBP)
- Manitoba Conservation Districts Association (MCDA)
- Upper Assiniboine River Conservation District (UARCD)
- Brandon University (BU)
- Assiniboine Community College (ACC)
- Manitoba Sustainable Development
- Manitoba Infrastructure
- Manitoba Agriculture
- City of Minot, North Dakota
- Town of Virden, Manitoba
- Aquanty Inc.
- ISM Canada – An IBM Company
- Assiniboine River Basin Initiative (ARBI)
- Manitoba Forage and Grassland Association (MFGA)

**Letters of Support**

- International Institute for Sustainable Development (IISD)
- Manitoba Habitat Heritage Corporation (MHHC)
- Manitoba Canola Growers Association (MCGA)
- Manitoba Agricultural Services Corporation (MASC)
- Prairie Improvement Network (PIN)

**Governance:** Project Management Team comprised of MFGA and ARBI representatives

# MFGA Aquanty Project Leaders

## Shared beliefs set leadership roots for ARB Project

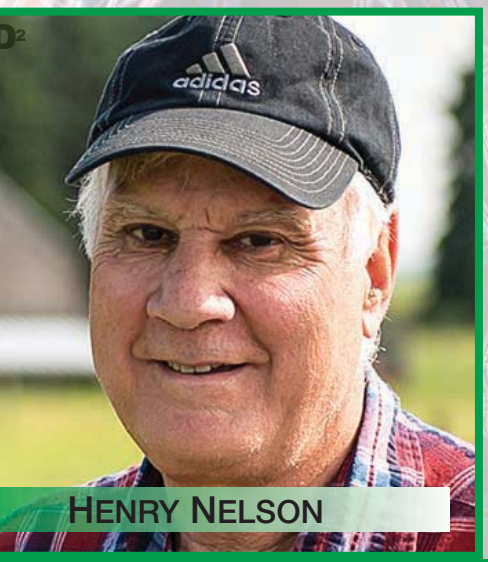
**By Duncan Morrison**

When a great opportunity to champion grasslands and water on the back of a cutting-edge modelling project landed on Henry Nelson's doorstep, he had a good idea of who he wanted in the trenches with him for the project's best success. In fact, the Manitoba Forage and Grassland Association (MFGA) vice-chair and Aquanty Project manager was pretty certain that well-respected former provincial veterinarian and longtime Manitoba agricultural leader Dr. Allan Preston would be a good choice.

"When I first started talking seriously with AgriRisk Initiatives, Agriculture and Agri-Food Canada (AAFC) about the vast potential of a sophisticated modelling project for the Assiniboine River Basin," recalls Nelson, "I knew immediately that Allan would be a good fit to help our MFGA team on the proposed project. And, Allan has certainly proven to be a strong choice."

As the current chair of the Assiniboine River Basin Initiative (ARBI), Preston saw the synergies between the fledgling project's objectives and his own relatively new organization. With the MFGA's Aquanty Project's focus on flood and drought mitigation in an agriculturally influenced landscape and the project's stated secondary focus on how grasslands and forages can play a role in times of drought and flood ahead, the MFGA was nicely positioned to lead the project. And, ARBI was a natural choice to be part.

Still, the project was a daunting assignment for an eager, though relatively small-horsepower, organization such as the MFGA. Nonetheless, Nelson embraced the opportunity and navigated the MFGA board and team through the project's early steps, gaining momentum with each one. He knew that the groups that the MFGA would need to work with on the project would be the same groups and decision-makers across the inter-jurisdictional lands and waters of the Assiniboine River Basin, a region Preston and his crew were working and networking in every day.



HENRY NELSON

The working partnership was finalized officially after Preston accepted the MFGA Aquanty Project steering committee co-chair and a project management team position invite from Nelson. These appointments required and received the full ARBI board approval.

But there is a bit more to the story than that. In fact, a solid grassroots connection was critical glue in the entire deal. Nelson and Preston share a vast affinity for rural farm life, in particular their respective and successful farm lives – Preston farms near Hamiota while Nelson's family farm is just outside Portage la Prairie near the Assiniboine River – and the livestock they have each raised on the grasslands they both champion. They also have shared a deep respect for one another based on their professional careers in the Manitoba Agriculture department.

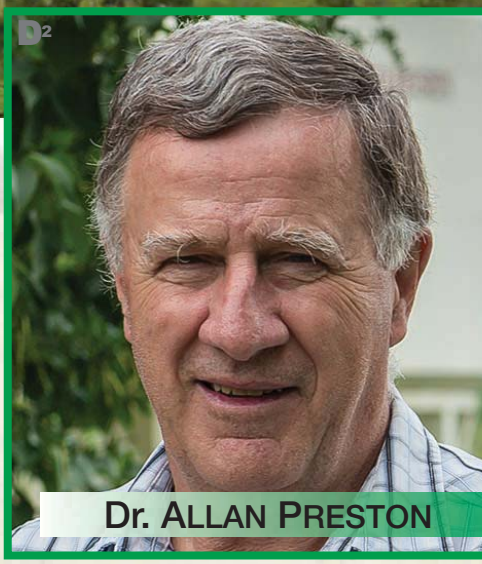
Preston preceded his official government duties with a 20-year run as a mixed animal veterinarian in Hamiota from 1975 to 1995. From 1995 to 2000, he was Manager of Veterinary Field Services for Manitoba Agriculture before serving as the Provincial Veterinarian from 2000 to 2005. He was assistant deputy minister in the province's Agriculture

department for the period spanning 2004 to 2011, including an 18-month overlap when he wore both hats. He retired from the civil service in April 2011 and remained active as a consultant before taking the ARBI reins in 2014.

**"The MFGA Aquanty project has the real potential to be a 'game changer'**

Nelson also enjoyed a sterling career in agriculture, serving as Weed Specialist from 1975 to 1979 and then as Director of Research and Program Development, Manitoba Crop Insurance Corporation (MCIC) from 1979 to 1989 before leading MCIC as General Manager from 1989 to 1993. He served as Executive Director, Manitoba Farm Mediation and Farm Land Ownership Boards from 1993 to 2006. During part of that time he represented Manitoba Agriculture on interdepartmental initiatives such as the Sustainable Development Coordination Unit and Ethanol and Biodiesel before retiring as Director of Agri-Energy, Manitoba Agriculture in 2008 after a two-year tenure. Over the years Preston and Nelson found themselves in the same meeting rooms, where their interests in grasslands, soil and water conservation often aligned.

Now, years later, they are reunited on the MFGA Aquanty project. Their shared "bucket list" philosophies for the health of the Assiniboine River Basin's farmlands, the preparation for flood and drought ahead, and showcasing the societal good in grass and water can shine through the project and via their collaboration, it's all systems go on the MFGA Aquanty project.



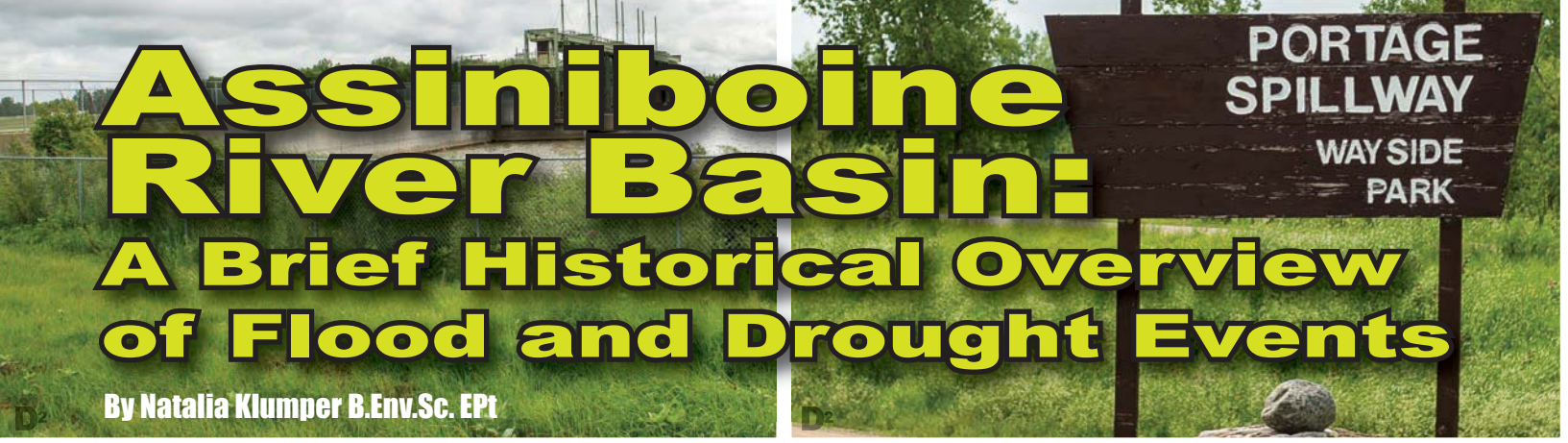
Dr. ALLAN PRESTON

True to their nature, Preston and Nelson choose to not make hyperbolic claims. Their greatest concern is to avoid unrealistically building people's expectations around the project. At the same time, their enthusiasm is contagious.

"The MFGA Aquanty project has the real potential to be a 'game changer' in how we collectively address future land and water management issues in the Assiniboine River Basin, through times that range from extreme droughts to damaging floods," says Preston. "We can and will do a better job in multi-jurisdictional land and water management across the entire basin, using a holistic approach engaging all players and stakeholders."

Nelson concurs. He sees the Aquanty HydroGeoSphere model as a valuable tool that will not only assist rural and urban people living in the basin in Manitoba, Saskatchewan and North Dakota to identify some causes and effects of floods and droughts, but will also benefit people and industries affected by these water events living outside the basin through the identification of cost-effective mitigation measures.

"We are so fortunate to have received the support of AgriRisk Initiatives, AAFC and Manitoba Agriculture as well as such great community support to bring Aquanty and IBM to work on this important issue," Nelson says.




# Assiniboine River Basin:

## A Brief Historical Overview of Flood and Drought Events

By Natalia Klumper B.Env.Sc. EPt

The Assiniboine River Basin (ARB) crosses over two Canadian provinces – Saskatchewan and Manitoba – and includes the US state of North Dakota. The basin consists of three distinct sub-basins: the Souris, the Qu'Appelle and the Assiniboine. The economy of the ARB is dominated by agriculture, with an estimated 1.5 million Prairie residents living and working within it.

Extreme flooding and drought events occur regularly in the ARB, devastating crops, property and infrastructure. These events are found to have some periodicity. Droughts have 14-, 22-, 30- and 100-year cycles – with 5- to 10-year durations – and floods are found to have 25-, 50- and 300-year cycles. A chronological review of the earliest documented flood and drought events appears to follow this trend:

**1826 & 1852**
Historical observations from 1826 and 1852 suggest that large floods occurred in the Assiniboine basin coincident with the better-known extreme events in the Red River valley.

**1882**
Following the not-well-documented flood of 1776, this was the largest flood on the Assiniboine River. It occurred in April/May, with discharges at Brandon, Headingley and Portage la Prairie.

**1902**
The Assiniboine River flood, discharging at Brandon in late June, was caused by heavy rains.

**1904**
The second largest ungauged Assiniboine River flood occurred in late April, discharging at Brandon and Headingley.

**1916**
Ice jams along the lower Assiniboine released water, causing damages amounting to thousands of dollars.

**1917-1921**
A five-year period of cereal crop drought occurred in parts of the Prairies, with the drought of 1921 in the northern part of the basin putting many farmers out of work, causing poverty and distress.

**1922**
A very severe Assiniboine valley flood resulted from heavy precipitation in 1921 which saturated the land, filling up the lakes and sloughs prior to freeze-up.

**1923**
Two stages of this flood started with ice jams triggering severe local floods until the jams were broken. The second flood stage, which lasted 25 days at Brandon, was higher than the first and caused by heavy snow and rain after the ice was gone.

**1931-1938**
During the "Dirty Thirties," dust storms, plant rust, heat waves, grasshopper plagues and water shortages plagued the Prairies for almost a decade, causing immense social and economic hardship. It is estimated that 250,000 people left the area.

**1948**
High discharges occurred on the Assiniboine River and its tributaries after nearly 20 years of low flow.

**1955**
Large discharges on the Qu'Appelle River caused spring floods of the Assiniboine River. Ice jams and heavy rains triggered massive flooding, and the entire Qu'Appelle Valley was declared a disaster area as millions of acres of farmland lay under water.

**1960-1968**
Drought plagued the Prairies during this period. 1961 was one of the most severe and widespread surface water droughts ever. Total net farm income dropped by 48 per cent compared to 1960, and 1961 was the worst drought year of the century for prairie wheat.

**1969**
Flooding of the Qu'Appelle River was caused by a rapid spring snowmelt following high fall and winter precipitation. 12,000 to 14,000 acres of agricultural land were flooded.

**1974**
In the winter of 1974, near-record snowfall resulted in extensive spring flooding of farms and ranchlands, in addition to the cities of Moose Jaw, Regina and Lumsden.

**1975**
An extremely high snow accumulation combined with long periods of rain during the runoff period led to the spring flooding of several parts of Saskatchewan, including the Qu'Appelle River Basin.

**1977-1993**
Several years throughout this period endured severe drought. In 1984, excessive moisture caused crop losses across northeast Saskatchewan earlier in the year, followed later by the worst agricultural drought since the 1930s to occur in the Prairies. Over 10,000 farms on the Prairies were affected.

**1995**
Rapid snowmelt sent very high flows into the Assiniboine River and the Red River below the Shellmouth Dam. Spring runoff and two heavy snowfalls in March contributed to the flooding problem. Many properties and agricultural lands suffered damage, with the hardest hit areas in Brandon and Shellmouth along the Assiniboine River.

**1996**
Heavy rainfall in the winter, high soil moisture levels and an unseasonably cool spring led to flooding. Thick ice flows and flood water caused extensive damage to urban and agricultural land.


## Flood in Red River Basin: 1997

Flows were above average in the Assiniboine basin, but could have been much worse as the basin escaped the major blizzard that produced the exceptional runoff in the Red River Basin.

### 1999

Melita, Manitoba, was threatened by the largest flood in the area since 1976. The Souris River spread to at least two kilometres wide at its peak, and almost topped the makeshift dikes. Over 80,0000 hectares of farmland was reported unseedable that year.

### 2005

Manitoba received large amounts of rain resulting in summer flooding. The regional municipalities of Daly, Sifton, Blanshard, Strathclair and Woodworth and the towns of Oak Lake and Rivers suffered urban and overland flooding of agricultural lands.

### 2011

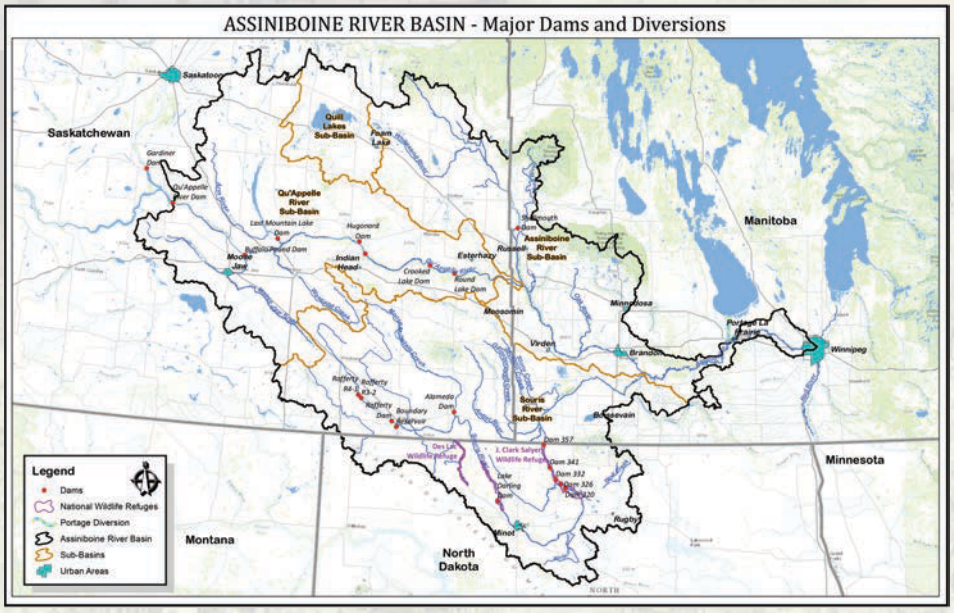
The Assiniboine, Roseau and Red rivers in Manitoba flooded between April 28 to June 17 due to fall rain and a cold winter. Several homes in Brandon and many other communities in Manitoba were evacuated due to extensive flooding. Extensive flooding in the cities of Weyburn and Estevan in Saskatchewan affected approximately 200 homes and hundreds of residents.

### 2014

After a relatively quiet spring flood season, heavy rainfall in western Manitoba and Saskatchewan led to record flows and flooding along the Assiniboine, Qu'Appelle and Souris rivers. An estimated 920,000 acres of farmland went unseeded for the 2014 season.

### 2015

Heavy rain across southeastern Saskatchewan led to localized overland flooding, road washouts, highway closures and local power outages affecting the Souris, Lower Qu'Appelle and Assiniboine basins. Peak flow levels on the Assiniboine and Qu'Appelle rivers exceeded those of the 2011 flood.




courtesy of ARBI & Manitoba Sustainable Development

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# GRASS CONNECTS LAND, W

By Duncan Morrison

The economic importance of Canada's forage and grassland scene is undeniable. With a direct economic value of $5.09 billion, forage is Canada's third largest crop, just behind wheat, valued at $5.2 billion, and canola at $7.3 billion.

"Forage is the backbone of Canada's ruminant industry and, with over 70 million acres in production, it is the largest land use sector in Canadian agriculture," says Cedric MacLeod, executive director of the Canadian Forage and Grassland Association (CFGA) and a beef farmer in western New Brunswick. "There is no doubt the forage and grassland industry plays a significant role in Canada's economy and is a critical foundation for sustainable growth and development throughout the Canadian agriculture industry."

What is not as clear is how to best work environmental considerations into the mix. Everyone knows grass is good. In fact, the major beef industry players, agricultural producer groups, governments and conservation interests all herald grass for the many ecological benefits that it provides to air, water, soil, climate change and biodiversity.

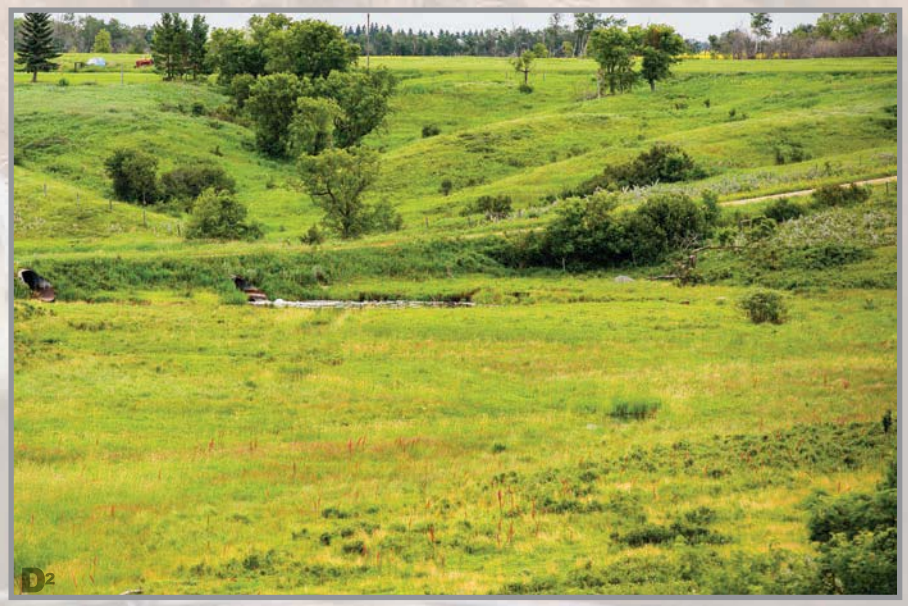
"Grassland ecosystems provide tangible and valuable benefits including water filtration, soil health, carbon sequestration, and biodiversity, amongst others and must be considered for these benefits in their management," says Dimple Roy, Director, Water Program for the International Institute for Sustainable Development (IISD).

As far as the Manitoba Forage and Grassland Association (MFGA) is concerned, grass is a connector of everything from water quality to carbon sequestration to soil health. Grass connects all. And that's why the support of AgriRisk Initiatives, Agriculture and Agri-Food Canada to help the MFGA Aquanty project become a reality on the Assiniboine River Basin (ARB) is being viewed as a huge boon in support of MFGA's forages and grasslands approach.

"The first objective of the MFGA Aquanty project is the development of the HydroGeoSphere model," says Dave Koslowsky, MFGA chair and a mixed beef and grain farmer from Killarney, Manitoba. "And this will be important as a risk planning and mitigation tool for flood and drought events across the basin. MFGA also has huge interest in the second objective of the project: to develop a detailed modelling-based assessment of how forages and grasslands influence the characteristics of the ARB under conditions ranging from flood to drought."

# ATER AND EVERYTHING ELSE

For the record, Koslowsky and the MFGA Aquanty project team members do not expect a huge redo of the existing agricultural scenario on the northern Great Plains. While returning grasslands to historic pasturing and land use in small land blocks has proven merit and high esthetic value, for as much as one might romanticize a return to the incredible great grasslands of the northern plains filled with bison, pronghorn antelope and all kinds of prairie biodiversity, the truth is that Canada's agricultural lands are vast and designed purposely with a primary focus on bolstering our nation's economy while feeding our nation and the world. The crops are here to stay. The key is to keep cropping effective while threading key areas of forages and grasslands and other practices such as cover cropping throughout the agricultural quilt. Enter the MFGA Aquanty project and the great potential to plan now for future flood and drought events.



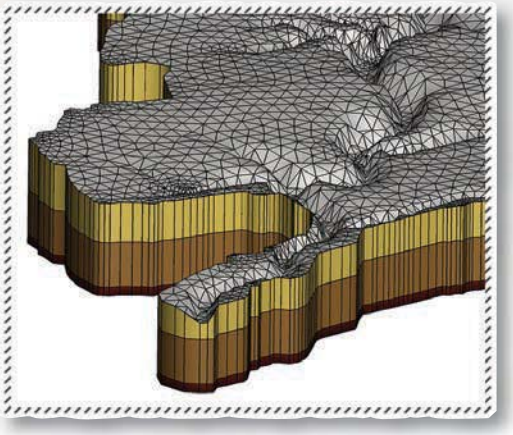
"MFGA will be one of two licence holders for the completed model – the other being Agriculture and Agri-Food Canada – which will put MFGA in close talks with stakeholders and partners," says Koslowsky. "This will allow us all to look at the landscape through the model to support land use decisions that make the best sense for the Assiniboine River Basin while showcasing the positive role of forages and grasslands in the equation."

As science continues to showcase values, natural solutions via grass, wetlands and soil are increasingly entering infrastructure discussions. In fact, in drought-racked California, state governor Jerry Brown recently signed legislation that recognizes watersheds as part of the state's infrastructure. In lay terms, the core signal from the legislation is that watersheds and the natural infrastructure within California's watershed can now be treated like traditional manmade infrastructure devices such as canals and levees with maintenance and repairs.

While the urgency that California faces with water and land use pressures is unique to its current situation, the signing has caught the eye of many around the world.

"Certainly, the MFGA Aquanty Project's focus on drought and flood will give us potential to look at mitigation options through land use planning throughout the region," says Koslowsky. "Understanding how it all fits together is a big task ahead of us and having the model look at the role of forages and grasses in the mix is huge for MFGA as we continue to advocate for these valuable plants and their many roles in the bigger picture. We know as producers that grass connects land, water, livestock and wildlife and we want to bring that forward every chance we get."

# aquanty answers hydrologic questio



Although Aquanty has existed only since 2012, the development of HydroGeoSphere (HGS), Aquanty's flagship water resources simulation platform, began in the early 1990s at the University of Waterloo.

Since its inception as an integrated groundwater–surface water model, extensive functionality has been added to HGS through the efforts of numerous PhD students, postdoctoral researchers and visiting scientists within the research groups of Professor René Therrien at Laval University, and the longtime holder of the Canada Research Chair in Quantitative Hydrogeology, Professor Ed Sudicky at University of Waterloo.

HGS has come to be recognized as one of the world's leading fully integrated hydrologic simulators. Hundreds of scientific journal articles have used HGS to help answer complex questions relating to how water (as well as potential water contaminants) moves across the land surface and through soil and subsurface geological materials.

Furthermore, much of HGS's functionality has been developed in order to address hydrologic questions in regions of the world where there are significant seasonal differences in weather and climate, like Canada. Snow accumulation and melting, soil freezing and thawing, and temporally and spatially varying crop and vegetation water requirements must all be considered. For all these reasons, HGS is ideally suited to serve as the hydrologic simulator for the Assiniboine River Basin (ARB).

For the Manitoba Forage and Grassland Association's Aquanty Assiniboine River Basin (ARB) project, not just one but five HGS models will be constructed, with coverage of the individual models ranging from over 150,000 km2 for the

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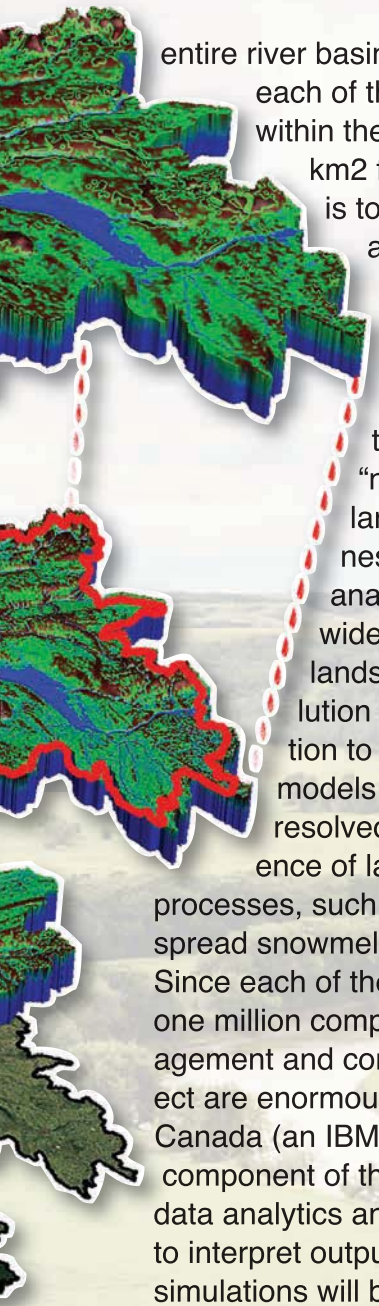
By Steven Frey



entire river basin, to 40,000 to 60,000 km2 for each of the three major sub-basins that lie within the major river basin, down to 7,000 km2 for the Birdtail Watershed, which is to be the subject of a very detailed analysis.

While the multiple models will have the ability to perform stand-alone simulations, they are being designed so they can take advantage of HGS's unique ability to "nest" local-scale models within large regional-scale models. Model nesting, which can be considered analogous to telescoping from a wide-field low-resolution view of the landscape to a narrow-field high-resolution view, allows hydrologic information to be translated across multiple models so that small-scale, very highly resolved simulations can reflect the influence of large-scale regional hydrologic processes, such as groundwater flows or widespread snowmelt or precipitation events.

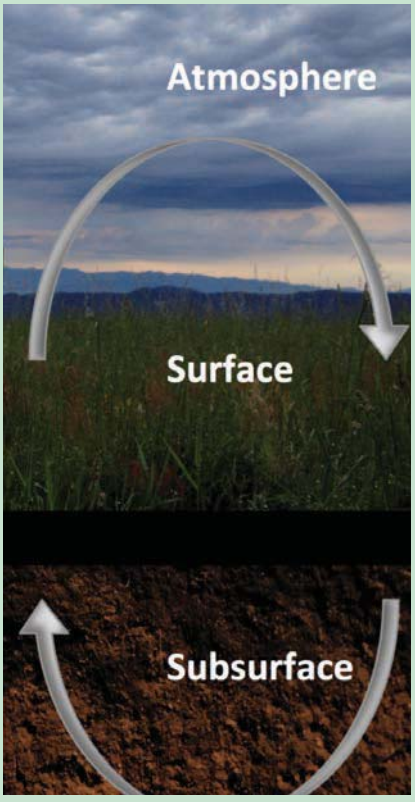
Since each of the HGS models will consist of over one million computational points, the data management and computational demands of this project are enormous. Hence the participation of ISM Canada (an IBM company) is an integral component of the ARB project. IBM advanced data analytics and visualization tools will be used to interpret output from the HGS models, and the simulations will be run on an IBM cloud-based High-Powered Computing platform. The combination of advanced data management technology provided by IBM and state-of-the-art water resources simulation science provided by HGS will result in a decision support tool for the Assiniboine River Basin that is best-in-class at a global level.

# Recent Advances With HydroGeoSphere

By Jason Davison

Water resources are fundamentally controlled by interactions between the atmosphere, surface and subsurface. While hydrologic modelling has traditionally simulated the influence of atmospheric conditions (weather and climate) on terrestrial (surface and subsurface) water resources, the influence of terrestrial water on atmospheric conditions is rarely considered. Hence surface and subsurface feedback to the atmosphere, which is an important consideration when assessing climate change, is disregarded.

In a recent development, HydroGeoSphere (HGS) has been fully coupled to the Weather Research and Forecasting (WRF) model, a state-of-the-art climate and weather prediction tool. The HGS-WRF combination offers an unprecedented capability to evaluate how terrestrial hydrologic conditions influence the generation and propagation of extreme weather events such as those that induce floods and droughts.



# Assiniboine River Basin Initiative: Three Rivers – One Basin

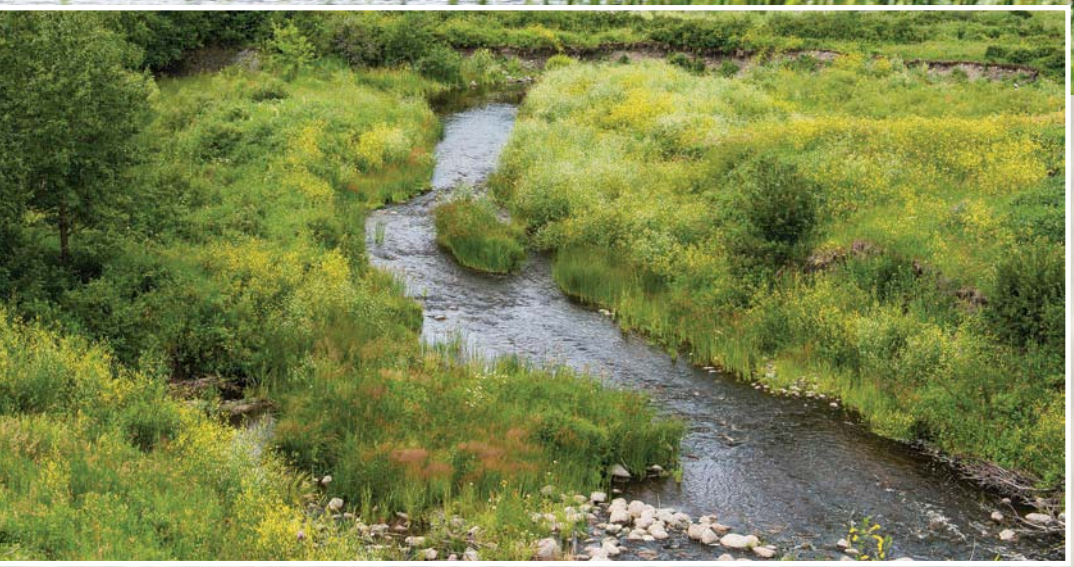
By Wanda McFadyen

***Water (noun): a colourless, transparent, odourless, tasteless liquid that forms the seas, lakes, rivers and rain and is the basis of the fluids of living organisms. In its many forms water transcends boundaries as it forms a watershed basin with unique flow characteristics based on the landscape.***

The Assiniboine River Basin encompasses the Qu'Appelle, Souris and Assiniboine River watersheds. It crosses over two Canadian provinces – Saskatchewan and Manitoba – and one US state – North Dakota. At its end point, the Assiniboine River Basin joins the Red River at the historic Forks of the two rivers in Winnipeg. The Assiniboine River also has waters diverted through the Portage Diversion into Lake Manitoba, with the final destination of all waters being Lake Winnipeg. The basin is approximately 162,000 square kilometres and home to just over 1.5 million people.

In 2008, the Province of Manitoba commissioned a study to review the potential development of an organization to pull a multitude of stakeholders across the Assiniboine Basin together. The study was completed and a committee formed but due to a variety of factors it did not move forward at that time. In 2013 the Prairie Improvement Network revisited this study to evaluate the feasibility of reengagement of the original committee and possible formation of an organization. This followed the major flood events of 2011 which had a devastating impact across the entire basin and heightened awareness of water-related issues. As part of the process a workshop was held in Virden in March 2014. The 130 participants from across the basin endorsed the development of an organization and asked that the committee host a conference in the fall of 2014 to further review prospective board structures and vision for the basin as well as priority items of primary concern.

The need for action was driven home when in late June and early July of 2014, portions of the basin once again experienced unprecedented flooding as a result of extreme rainfall events. These events were highlighted at the fall 2014 conference in Regina. The primary outcome of the conference was the endorsement of the Assiniboine River Basin Initiative (ARBI) as an organization; the members of the original steering committee were named as the first board of directors and mandated to expand to



51 members in total (17 from each jurisdiction). The attendees also identified key areas of concern that they would like to see further developed or reviewed as the new organization moved forward in its development. One of the primary priority items was the development of a basin-wide model that could assist all stakeholders in future planning regarding flooding or drought at both rural and urban levels.

Over the course of 2015 ARBI began the process of becoming a legal entity in both Canada and the US, and further developed its board structure and defined the executive level. Funding was also of primary importance to the organization and various levels of funding support were developed and presented to stakeholders across the basin. The Province of Manitoba and the North Dakota State Water Commission were both early (and continuing) financial supporters. The board also began to discuss and review potential projects that stakeholders had identified of primary importance. This included not only the ARBI's internal Framework Plan but other projects such as LiDAR and basin-wide modelling.

It was during this time that the Manitoba Forage and Grassland Association (MFGA) approached ARBI regarding the delivery of the proposed MFGA Aquanty HydroGeoSphere modelling project they were leading with Agriculture and Agri-Food Canada. The model concept, focused on both flood and drought mitigation, seemed to fit the bill for what basin stakeholders had identified as a key priority item at the 2014 conference at both the rural and urban levels. Upon further discussion and review by the ARBI board the model was endorsed, as well as ARBI's involvement on the project's steering and management committees.

With the development of the model, basin stakeholders will have access to a world-class tool that will assist them in identifying some causes and effects of floods and drought and allow for the development and identification of cost-effective mitigation measures.

Cooperative projects such as the MFGA Aquanty project will assist in the development of a resilient Assiniboine River Basin where all residents can adapt to change and achieve environmental, social and economic sustainability through collaborative actions across the basin.

# Crossing Commodity Lines To Benefit All Manitoba Farmers

**By Jennifer Paige**

The Manitoba Canola Growers Association (MCGA) has traversed commodity lines to support the Manitoba Forage and Grassland Association (MFGA) Aquanty modelling project.

Lead by MFGA and bolstered by the support by the Assiniboine River Basin Initiative on the project management team, the Aquanty modelling project aims to enhance the scientific understanding of how the landscape is affected by flooding and drought within the Assiniboine River Basin.

"We want to use our checkoff dollars to help and support Manitoba producers and we think the Aquanty project will have spillover benefits to farmers across the entire province, not just for forage producers or those within the ARB," says Charles Fossay, president of the MCGA.

Multiple flooding events in Manitoba over a number of years have resulted in crop losses and property and infrastructure damage, and created a number of hurdles for farmers.

"If I were to describe our biggest challenge in crop production, it is the weather," says Brian Chorney, secretary for the MCGA. "In most cases, excess moisture has been the biggest challenge for producers in a lot of different areas."

The Aquanty project looks to develop new risk management tools that can better predict the impact of weather events, something the MCGA believes is sure to benefit everyone in the province, and will especially be of keen interest to agricultural producers.

"You can't manage what you don't know. The more information we as canola growers, or as farmers in general, can have, the better management decisions [we can make]," Chorney says.

With his operation located downstream from the Portage Diversion in Starbuck, Fossay has seen firsthand the need for a better understanding of the province's hydrological landscape. In 2011, he was one of numerous stakeholders in discussions with the Province around the crush of water coming down the Assiniboine River.

"I was on the edge of the potential flood area when the Province was talking about cutting the dike just east of Portage la Prairie," Fossay says. Fossay explains everyone prepared for the worst but by the end of the 2011 flood's peak water flows, no large volume of water ended up moving through the area.

"If we had more accurate information, maybe we would be able to be better prepared. Instead of trying to solve the problem with an axe, we could solve the problem with a scalpel," he says.

The Aquanty modelling project intends to develop an integrated hydrologic model for the basin, identify preventative measures and implement risk prevention and mitigation activities. As the project proponent, MFGA will be one of two licence holders for the model along with Agriculture and Agri-Food Canada's Agri-Risk Initiative. MFGA is currently developing a strat-

egy for how best to get the model into the hands of key players on the landscape. Fossay, for one, likes the potential.

"If we have a better prediction model that can tell us where the water will flow and who will be affected, maybe things like this will only have to impact a few dozen people as opposed to a few hundred or thousand," he says.

Along with assisting the provincial government in predicting water flows, Fossay believes the project will also be of great value to the province's municipalities.

"With this project, the municipalities would have a better idea of what kind of infrastructure they will need when it comes to sizing drainage ditches and culverts. As producers, if the municipality is better prepared with their ditches, then you know the water will move off of your land in a more timely fashion," Fossay says.

Chorney agrees and says that where he resides in East Selkirk, municipal infrastructure struggles and often fails to keep up with water flows.

"We had a significant amount of rain this year and the ground was very saturated for a long time, so we were quite dependent on the municipal drains to take away a lot of the excess moisture," Chorney says. "If we can help the municipalities prepare better, they can hopefully have their main drains in such a condition that they can take away some of this excess water to help us to be more productive."

Fossay first learned of the MFGA Aquanty modelling project at a Keystone Agriculture Producers (KAP) board meeting.

"When we discussed the Aquanty project at the KAP board meeting, we discussed the need for raising this with other Manitoba commodity groups to see if other groups would be willing to show their support for the project as well, because excess moisture is impacting all commodities and this modelling system is going to have benefits for everyone," Fossay says.

Henry Nelson is the project manager for the MFGA Aquanty project. He says the MCGA support is exactly the kind of support that the MFGA Aquanty project needs.

"When we undertook this project, we knew it would have vast potential for numerous stakeholders across the Assiniboine River Basin to help plan and mitigate for future flood and drought events," says Nelson. "We are very pleased with the support we have received from the MCGA and we will be pointing to this support as a sign of leadership and potential as we speak to other stakeholders across the basin. There really is great opportunity for everyone to get onboard and behind this project."

The MCGA has backed the Aquanty project through a letter of support and a monetary contribution.

"Ultimately, yes I am a canola farmer and a director with the MCGA, but I know that we need to look at research projects from a big picture perspective and aim to ensure that we are doing what we can to help Manitoba canola growers, and farmers in general, to be as productive as possible," Chorney says.

# Bob Sandford

# Q&A Fitting The Pieces Together – In Time

*Robert (Bob) Sandford* is the EPCOR Chair for Water and Climate Security at the United Nations University Institute for Water, Environment and Health. In this capacity Bob was the co-author of the UN Water in the World We Want report on post-2015 global sustainable development goals relating to water. Sandford's résumé contains numerous efforts and committees that put him at the table with or in front of global leaders regularly and he has also written many books and papers on water issues. Given Sandford's keen interest in and well-regarded expertise on Canadian and global land and water issues, The Grasslander's editorial team recently posed some key questions to him to gather his thoughts on the Northern Great Plains of Canada, including the Assiniboine River Basin that the MFGA Aquanty project will model.

***What role can the Northern Great Plains of Canada and the United States play in global health and prosperity, particularly in light of recent climate change discussions?***

The Northern Great Plains of Canada and the United States can play an enormous role in sustaining human health and prosperity globally and regionally. Our two nations can ensure a sustainable future by collaborating as effectively as possible to become as resilient as possible to deeper and more persistent droughts and the extreme weather events that we must expect as temperatures at the centre of the North American continent rise disproportionately in terms of planetary averages in response to accelerating hydro-climatic change.

***Drilling down on that, where do you see the Assiniboine River Basin on the global front – both in the present and the future?***

Although it is now presently plagued by persistent flooding, the Assiniboine River Basin's agriculture remains vitally productive. Sooner rather than later, however, rising temperatures are likely to drive the region across an invisible hydro-climatic threshold into a new climate regime. Temperatures in this region are expected to rise by as much as 5˚C to 9˚C as this century progresses. In my view these projections make the Assiniboine River Basin one of the most vulnerable important agricultural regions in the world.

***Water issues are of global concern. How are the Northern Great Plains positioned in regard to future land use and water resources, in particular, given some of the challenges facing the region?***

In my estimation, the unintended consequences of the



Bob Sandford

last agricultural revolution in the region and rapid changes in hydro-climatic regimes globally make the Northern Plains particularly vulnerable. While crop yields are likely to rise, perhaps dramatically, during periods of warmer temperatures and adequate rainfall, the region remains unprepared because of the lack of coordination of agricultural practices, policies and habits to survive droughts of the depth, extent and persistence we are already witnessing in parts of the US and elsewhere.

***Agriculture has a major role to play in every key category from the economy to the environment to world sustainability. How do you see our agricultural lands as solutions for the future?***

The good news is that through remarkable efforts, food production appears to have kept up with population growth. Though largely unsung, modern agriculture has been stunningly successful in increasing food production. It already produces sufficient calories per capita to feed a global population of 12 to 14 billion people. The bad news is that to feed a global population of 12 billion in a warmer world, we will need agricultural production to increase by at least 60% based on today's demand. Leaving aside the issue of water availability, if the unharvestable part of the planet's primary plant and animal production is subtracted from the remaining percentage of available land, that leaves only 10% of the earth's total net primary production available for additional human use including the expanding of agriculture. This suggests great urgency in acting to make the existing highly productive agricultural regions like the Northern Great Plains sustainable in the face of both hydro-climatic and earth system change.

***In 100 years, you would like see…***

What we need is another green revolution – but this time focused also on soil health as a means of mitigating and adapting to extreme weather events such as droughts and floods. We need to develop water retention and the ability of healthy soils to pull carbon dioxide from the atmosphere, and capture and store it, in the vast agricultural landscapes we are going to need to create a sustainable future. The Northern Great Plains region of North America should be a leader in that revolution. Given the work you are doing together, there is no reason that revolution can't start here – collaboration between all interest groups must result in effective action before crisis puts solutions out of reach.

# Birdtail Watershed:
## A High-Resolution Focus

By Duncan Morrison

As the manager of the Upper Assiniboine River Conservation District (UARCD) in the scenic Birdtail Watershed of western Manitoba, Ryan Canart has a great grasp of the conservation needs and land use challenges of the jurisdiction he works in. Canart's determined push for healthier waterways, forests, grasslands, crops, soils and wildlife populations through tangible and innovative programs is the backbone of his everyday work.

"We have a good mix of land use in the Birdtail Watershed across a wide range of topography features along the rivers, valley, fields and pastures," says Canart. "And from a visual perspective, it's time we looked at changing some of our land use practices, such as farming crops right up to the edge of the river. Large permanent buffers established along the river edges help slow water and runoff and help stymie shoreline erosion. Bank erosion is a natural process but it becomes really accelerated when there is no deep-rooted vegetation."

Fittingly – or perhaps unfortunately – Canart's comments came as he surveyed a low-level road bridge underwater on the Assiniboine River about five minutes from the UARCD office in Miniota. A surge of water from a steady week of late autumn rainfall had sent water cascading through the many creeks of the watershed, and the valley's meandering rivers were absorbing the crush of extra water as they increasingly are forced to do. Except this day was in late October, a time of year that traditionally features low waters rather than the swift, bloated current rippling down the Assiniboine River.

From this vantage point, one can quickly understand why Canart was pleased to hear that the Manitoba Forage and Grassland Association's (MFGA) Aquanty project had selected the Birdtail Watershed as the representative local region that their HydroGeoSphere (HGS) model would focus on for a closer look at flood and drought mitigation, as well as to examine the role of forages and grasslands in improving the Assiniboine River Basin.

"There were so many watersheds to choose from all across the Assiniboine River Basin and not one of them would be a poor choice

for the MFGA Aquanty model to look at more closely," says Canart. "Here in the Birdtail, we want to know why floods and droughts behave the way they do. We can use the model as an educational tool and as a way to dispel myths among landowners and land managers and work toward a healthier landscape."

Steve Frey is one of Aquanty Inc.'s senior scientists and Aquanty's lead on the HGS model for the MFGA Aquanty project. Frey, who received his PhD in 2011 in Earth Sciences at the University of Waterloo, is currently leading an initiative to better understand climate and land use related risks to surface water and groundwater resources through the use of advanced numerical models. Frey says the opportunity to work on the Birdtail Watershed will be valuable to showcase the extensive functionality of the HGS model.

"The Birdtail Watershed was chosen as a high-resolution focus area because it encompasses a large enough area to be relevant for a wide range of stakeholders," says Frey. "It also has diverse land cover with a relatively balanced combination of grassland, cropland and forest, and is directly influenced by surface water management infrastructure."

Land use is dominated by the primary industries of agriculture and oil; the northern reach of the Bakken oilfield includes the southern portions of the Birdtail Watershed. Canart says he wants to use the findings of the HGS model to support the UARCD's water management programs such as the small dams program that UARCD has developed across the watershed for water storage, flow reduction and wildlife habitat.

"We want to do what we can do on the ground to support and improve the model findings," says Canart. "This model will help the UARCD integrate programs, address issues and develop the most effective programs and detailed watershed plans."

Canart wants the Birdtail Watershed component of the HGS model to be learned from and embraced by colleagues from the Manitoba Conservation Districts Association (MCDA). Shane Robins, MCDA executive director, is all for that.

"UARCD has a long history of innovative soil and water management on the landscape within the Birdtail Watershed," says Robins. "Having this level of detail from the model being made available for them will be something MCDA will be watching closely as to how it may pertain to our other conservation districts."

## WHAT IS A WATERSHED?

Source: Assiniboine-Birdtail Integrated Watershed Plan

A watershed is defined as an area where all surface waters flow to a common point. For ease of management, we often designate a point along a river as the bottom of a watershed. For the Birdtail Watershed that point is the Assiniboine River crossing of Provincial Highway #83 in the Rural Municipality of Miniota. Surface and groundwater is connected within a watershed and either flows downstream across the landscape through waterways or vertically through the various layers of soil and substrate. A watershed extends beyond the soil and water to include the plants and animals that depend upon these systems for life.

# Did you know?

Manitoba forage & grassland Association

# Forages & Grasslands
## are Canada's Most Important Plants for the many benefits they provide

**80%** of beef cattle feed

in Canada is forage based.

The total value of forage production in Manitoba is approximately

**$525** million per year

Grasslands cover approximately

**1/3** of total farm land

in Manitoba - that's 6 million acres!

An acre of forage can prevent

**2** million pounds

of soil erosion from entering our waterways & drinking water sources.

**↑%** Forage grasses provide most of the nutrition for livestock & wildlife

& help our agricultural lands hold & slow water in times of drought & flood.

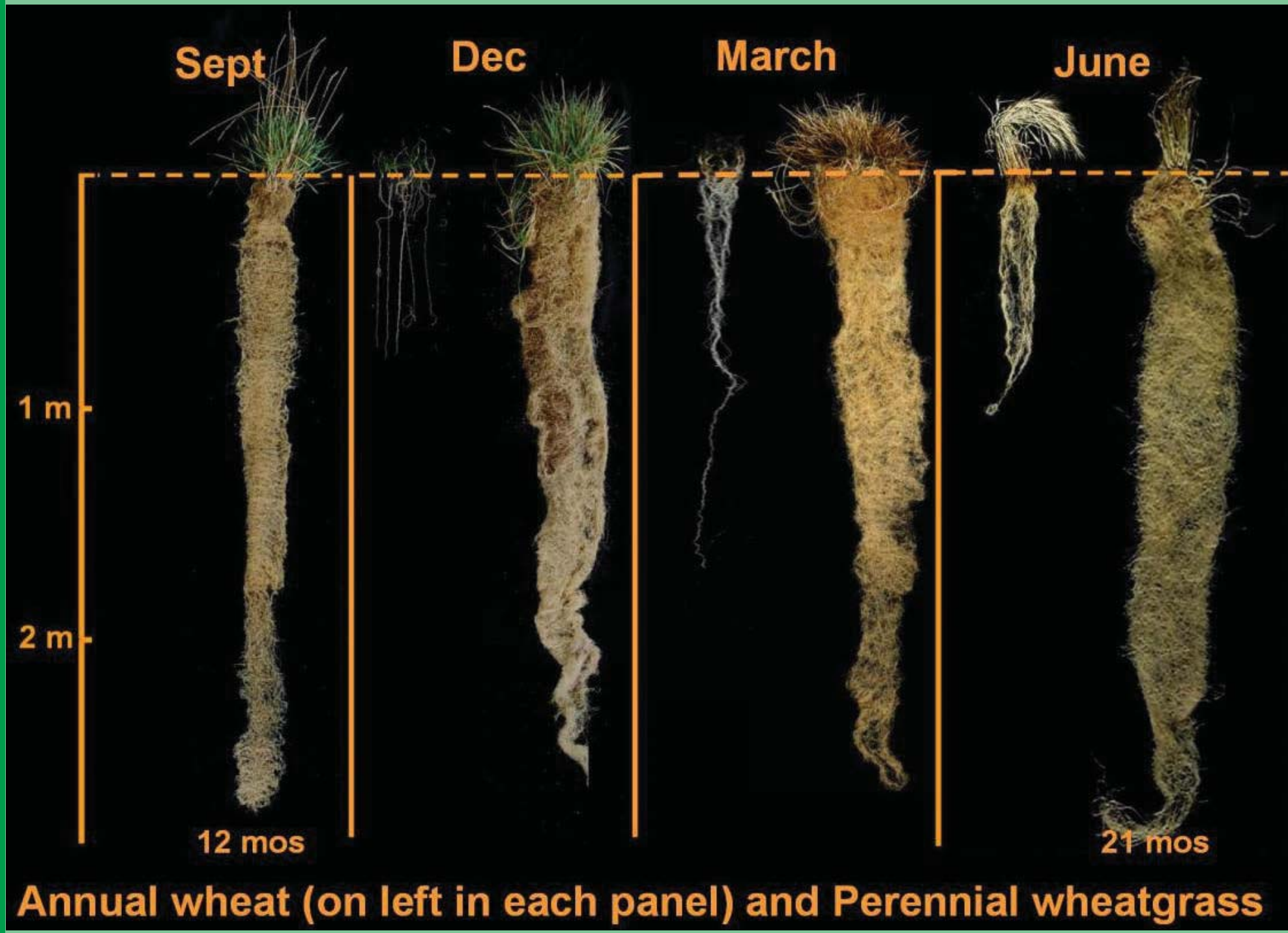
The recreational benefit of grasslands in Manitoba is estimated to be

**$41** million per year

These valuable plants capture carbon & are vital cogs in our global health.

*design by Graphiti Graphics for MFGA*

**MFGA** interacts with tens of thousands of Manitobans through our communications, collaborative projects, and outreach that promote the importance and well-being of Manitoba`s forages and grasslands. On a national scale, **MFGA** proudly partners with like-minded groups across Canada.




Annual wheat (on left in each panel) and Perennial wheatgrass