2022-23 annual report

GenomePrairie

MEETING THE CHALLENGES OF TODAY

GENOME PRAIRIE IMPACTS

the impact

Through collaboration, Genome Prairie's operational activities and investments in projects create economic and social contributions in Manitoba and Saskatchewan.

Some of the ways Genome Prairie has an impact include:

- Addressing regional and national issues
- Advancing local talent
- Building public and private sector partnerships
- Developing new technologies
- Contributing to training and employment opportunities
- Facilitating industry solutions
- Establishing expertise, capabilities and capacity
- Leveraging funding

5:1 leverage power

For every dollar that is invested in Genome Prairie activity by the provinces, another five dollars of near-term economic impact was generated (2012-22).

51
funded genome projects

$433M
total project investments

$338M
increase in total GDP in SK and MB

3,365
Full-time jobs created in SK and MB

From 2005-March, 2023. Estmated benefits based on updated MNP economic impact study.

2022-23
ANNUAL REPORT

We acknowledge we are on Treaty 1, 2, 4, 5, 6, and 8 Territories, and ancestral lands of the Anishininewuk, Cree, Dakota, Dene, Lakota, Nakota Anishinaabeg, Dakota Oyate, Dene, Denesuline, Lakota, Nakota Anishinaabeg, Nehethowuk, Saulteaux, and Métis nations.

We acknowledge northern Manitoba includes lands that were and are the ancestral lands of the Inuit.

We respect the spirit and intent of Treaties and Treaty Making and remain committed to working in partnership with First Nations, Inuit and Métis people in the spirit of truth, reconciliation and collaboration.

THE GENOME PRAIRIE PATHWAY

Our Mission

Driving genomics research, development and knowledge translation to better protect, feed, heal and empower the people of Manitoba, Saskatchewan and beyond.

Our Vision

Building a healthier and more productive environment for everyone through genomics.

Project Development

Genome Prairie serves as an engine for economic development. With offices in Saskatoon and Winnipeg, Genome Prairie identifies and refines new project opportunities, facilitates national and international collaboration, and aligns partners and resources to ensure the success of selected research projects.

Research Management

Our projects are at the forefront of research and development in genomics and related biosciences. Genome Prairie's team strives to bring together significant expertise and resources from different academic institutions and industries across Canada. The scale and complexity of these initiatives requires strong project management to optimize successful completion of goals and objectives.

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MEETING THE CHALLENGES OF TODAY

"DISCOVERY FOLLOWS DISCOVERY, EACH BOTH RAISING AND ANSWERING QUESTIONS, EACH ENDING A LONG SEARCH, AND EACH PROVIDING THE NEW INSTRUMENTS FOR A NEW SEARCH."

-J. ROBERT OPPENHEIMER

Genomics is an indispensable

tool in meeting the multifaceted challenges of today's world. From revolutionizing healthcare through precision medicine to transforming agriculture for sustainable food production and addressing environmental issues by providing tools to understand better and help protect Canada's environment, genomics holds the key to a brighter and more sustainable future. As technology advances, the potential of genomics to drive innovation and solve global challenges will only continue to grow, offering hope for a healthier, more resilient, and environmentally conscious world. In that respect, Genome Prairie is meeting the challenges of today.

Unveiling the Power of Genomic Research: Revolutionizing Human Health Solutions

In the 21st century, genomics has flourished, providing groundbreaking solutions that have revolutionized various sectors, including health, food production, and environmental sustainability. From the earliest days of genome sequencing to the present day, the wealth of information gleaned from genomics has paved the way for innovative solutions for some of the most pressing challenges facing life on earth.

As human populations on every corner of the globe continue to grow, the pressures on food production, plant and animal health and the environment have escalated.

Genomic research enabled scientists to decode the human genome, unlocking secrets hidden in our genetic material. The Human Genome Project, completed in 2003, was a significant milestone that paved the way for countless discoveries and will continue doing so in the future. Researchers have made great leaps in understanding our genes and their functions by sequencing the entire human genome. The sequenced human genome has provided an invaluable resource for studying how diseases affect us and how our bodies meet the challenges of illness. The human genome has allowed us to observe the range of genetic variations that lead to humanity's awesome diversity and identify variants associated with serious health disorders.

In the 23 years since its establishment, Genome Prairie has focused on providing the needed support to meet current and future challenges in food production, human and animal health, and protecting the world's delicate environment. Over the past year, our journey toward meeting the

challenges of today continued to flourish and advance:

I. Transforming Agriculture and Food Production

In a world grappling with the challenges of a growing population and climate change, genomics has emerged as a potent tool to transform agriculture and enhance food production. According to a recently published estimate from the Food and Agricultural Organization of the United Nations, the ongoing rise in the world's human population means global food production will be unable to meet demand by the year 2050. More than ever, Canadian farmers can access crop varieties and livestock improved through genomics-enabled breeding programs. These improved varieties have been developed to be more dependable, vigorous and resilient to environmental stressors, pests, and diseases. By identifying key genes associated with desirable traits, scientists can more effectively than ever breed crops with higher yields, better nutritional content, and improved resistance to adverse conditions.

Integrating genomics and data analytics has given rise to precision agriculture, a modern farming approach that optimizes resource use and minimizes environmental impact. By utilizing genomic data from crops and livestock, farmers can make informed decisions about selecting varieties and germplasm, applying fertilizers, pesticides, and water, reducing waste and increasing efficiency.

This year, Genome Canada, in collaboration with Canada's six genome centres, including Genome Prairie, launched the Climate-Smart Agriculture and Food Systems (CSAFS) challenge-driven genomics research and innovation initiative. This $70M program will promote collaboration and innovation to address challenges facing Canadian agriculture in a rapidly changing climate while seeking ways of reducing greenhouse gas emissions from food production. The CSAFS initiative will also establish pan-Canadian coordination hubs for knowledge mobilization and the data generated from this genomics research.

4DWHEAT's Dr. Curtis Pozniak
Source: University of Saskatchewan

Through the CSAFS initiative and current projects like 4DWHEAT and EVOLVES, Genome Prairie is furthering the development of grain and pulse crops with lower input requirements, greater stress tolerance, and improved competitiveness in the global commodity marketplace.

Meanwhile, genomic advances against infectious diseases continue in livestock production, enabling Canadian farmers to produce healthier, more productive, and disease-resistant animals. Combating disease will improve the quality of meat and dairy products and reduce the need for antibiotics, mitigating the risk of antibiotic resistance in animals and humans. In projects like ASSETS, Genome Prairie continues to support research to provide livestock producers with powerful tools to combat the spread of antibiotic resistance and the use of antibiotics to treat a significant issue in feedlots: bovine respiratory disease. Such research

ASSETS research team's use of Oxford Nanopore sequencing equipment has played a key role in advancing discoveries
Source: Omics and Precision Agriculture Laboratory (OPAL)

has the result of producing healthier and more profitable herds. Fighting disease while enhancing genetic diversity is also part of Genome Prairie's BIG Project, which aims to protect Canada's vulnerable Wood Bison population.

II. Advancing Personalized Medicine and Healthcare

In recent decades, genomic research has emerged as a powerful tool in medicine, unravelling the intricacies of our genetic makeup and providing groundbreaking insights into human health. This rapidly advancing field has opened up new possibilities for understanding diseases, identifying risk factors, and developing personalized treatments. With each breakthrough, genomic research brings us closer to a future where diseases can be accurately predicted, prevented, and effectively treated.

One of the most significant contributions of genomics to the healthcare sector is personalized medicine. Genomic technologies enable healthcare providers to tailor treatment plans and medications based on a patient's genetic makeup. This approach has revolutionized disease diagnosis, risk assessment, and therapy selection. With genetic testing becoming more accessible and affordable, patients can now obtain crucial insights into their genetic predispositions for various diseases, allowing them to adopt preventive measures.

Genomic advances in precision medicine have provided renewed hope for individuals affected by rare genetic disorders. By studying the genetic basis of these conditions, genomics researchers are gaining insights into their underlying mechanisms and identifying potential therapeutic targets. Genome Prairie-supported projects like the Canadian Prairie Metabolic Network (CPMN) have reduced the time required to obtain a diagnosis for metabolic disorders from two years to three months. The quicker time to diagnosis means that patients in the prairie region with rare genetic disorders can start their treatment programs earlier and with less uncertainty. This approach allows for better treatment plans, the identification of other genetic risk factors, and the development of targeted therapies. Furthermore, as patients' sequences are reanalysed multiple

times, patients may be able to get a positive diagnosis as our understanding of rare genetic disorders improves. CPMN tailors treatments to each patient's needs and characteristics by analyzing individual genetic information.

Meanwhile, developing genomics tools to help detect and identify emerging pathogens is critical in precision and preventative diagnostic strategies. The Genome Prairie COV3R project is now developing tools to help pave the way toward early detection of viruses that could pose a significant danger to Canadians and beyond.

Genomic research plays a vital role in detecting diseases at their earliest stages, enabling proactive interventions and potentially preventing the onset of illness altogether. By identifying genetic markers associated with specific diseases, researchers can develop screening tests that detect risk factors long before symptoms appear. Researchers have identified specific genetic mutations that drive tumour growth by analyzing the genetic basis of diseases like cancer. This has led to targeted therapies focusing on these unique mutations, improving treatment outcomes while minimizing side effects. Genome Prairie projects like the Ovarian Cancer and Helicobacter pylori Genomics projects focus on identifying patients with serious diseases and opening doors toward more effective treatments.

Genomic research contributes to developing public health initiatives to prevent and manage the spread of infectious diseases. By studying the genomic sequences of pathogens, researchers can track their evolution, identify potential drug targets, and design targeted vaccines.

III. Addressing Biodiversity & Environmental Challenges

Genomics is becoming increasingly pivotal in addressing environmental challenges, including pollution, climate change, and biodiversity loss. Metagenomics involves analyzing the diversity and function of an ecosystem's microbial community through its DNA sequence. Advances in sample collection and DNA sequencing have led to the use of environmental DNA (eDNA) to non-invasively categorize all living organisms in aquatic or terrestrial ecosystems.

This approach has proven invaluable in monitoring water and soil quality, identifying pollution sources, and assessing human activities' impact on ecosystems. By understanding the genomic makeup of organisms within these environments, scientists can design targeted strategies for conservation and restoration. These strategies are fundamental to how Genome Prairie meets today's environmental challenges in projects like FLOWTER, which develops genetically engineered pods to remediate fuel contamination in Canada's delicate (often remote) freshwater lakes.

Moreover, genomics has facilitated the development of bioengineered microbes that can degrade pollutants and remediate contaminated sites. These engineered microbes can break down harmful chemicals into non-toxic substances, providing a sustainable solution to environmental pollution. GENICE II, in collaboration with northern indigenous communities, is developing hand-held genomics testing tools to identify and monitor fuel contaminants in sea ice in Canada's far North.

The 2022-23 year was another period of great achievement for Genome Prairie. Genome Prairie, representing Manitoba and Saskatchewan within the Canadian genomics enterprise, is now, more than ever, helping to advance research that will improve Canadians' lives by making our food more sustainable and resistant to climate change and bettering both our own health and the environment we live in.

ANNUAL MESSAGE FROM THE CHAIR

DR. PETER W.B. PHILLIPS

Now more than ever, Genome

Prairie is positioned to play a prominent role in developing world-class genomics-based solutions.

The challenges we face in the Prairies and beyond are daunting. The continuing rise of the world's atmospheric temperatures is posing direct threats to our environment and the food we grow. Meanwhile, the dangers of disease continue to pose significant challenges in protecting the health and well-being of human and animal health.

As it has since its founding 22 years ago, Genome Prairie is working with research and industry partners to develop genomics-based tools to meet the needs of today and tomorrow. I am pleased to report that over the past year, Genome Prairie project teams have made significant advances in agriculture, human and animal health, and developing strategies to help reduce carbon outputs contributing to our changing climate.

Genome Prairie's senior management team continues demonstrating exemplary leadership, with CEO and President Mike Cey, Chief Financial Officer Pat Pitka, and recently appointed Chief Scientific Officer Dr. Lester Young. Each has played an integral role in helping the organization reach its primary strategic goals, including sector planning, supporting cutting-edge genomics research in Manitoba and Saskatchewan, and sharing stories of remarkable achievements and breakthroughs. This year, I was chosen to chair Genome Prairie's volunteer board of Directors. With so many exciting

opportunities for genomics in the Prairie region and beyond, I am eager to work with my exceptionally talented fellow board members and Genome Prairie's dynamic administration. As we move into another year, I would like to acknowledge two departing members, Bill Johnson and Dr. Jenisa Naidoo. During their years of service on our board, Bill and Dr. Naidoo contributed significantly to making Genome Prairie stronger than ever. I want to thank Bill for stepping into the chair position during the COVID-19 pandemic and Dr. Naidoo for helping to advance our presence in Manitoba.

I also want to acknowledge and welcome three new board members, Dr. Susan Blum, Ms. Gina Feist and Mr. Al Shpyth. All three bring exceptional knowledge and professional experience to help guide the organization as it seeks to expand its genomics research portfolio.

Genome Prairie is well-positioned for even greater success. With a well-grounded board and a nimble and talented executive and administration team, Genome Prairie is ready to aggressively advance genomics research in Saskatchewan and Manitoba.

We live in a world of challenges affecting our health, food and environment. We also live in a world with the tools to meet many of these critical challenges, including the power of genomics. In the spirit of meeting the challenges of today, Genome Prairie strives to support the development of solutions that will make the world a healthier and more prosperous place for all.

2022-23 Genome Prairie Board


Bill Johnson (Chair)


Dr. Peter W.B. Phillips (Vice-Chair)


Patty Rosher


Kendra Mueller


Dr. Terry Fonstad


Dr. Annemieke Farenhorst


Hon. JoAnne Buth


Dr. Shawn Gibson


Dr. Jenisa Naidoo


Dr. Curtis Rempel

ANNUAL MESSAGE FROM THE PRESIDENT & CEO

MIKE CEY

The past year has been one

of success and achievement for Genome Prairie in project development, with several new projects awarded funding. This, combined with enhanced communication and external relations efforts has positioned us well to achieve exceptional results in the coming years. Gratitude and thankfulness is extended to our excellent staff, Board and key stakeholders, including an extraordinary complement of world class researchers for their excellence in execution and dedication to making an impact and bringing real value to the world around them. Several new projects have been developed and funded that will bring significant outcome and value to Manitoba and Saskatchewan in the coming years in both human health and agriculture.

The theme of our annual report this year is "meeting the challenges of today". This is perhaps, a particularly appropriate theme as it aligns well with the approach the people of this space have taken to great effect out of necessity over an extended period of time. We are a sparse population that inhabits an environment that is, at times, both bountiful and harsh in a relatively remote part of the world. Understanding this shared reality well allows us to focus our thoughts and our actions on meeting our most pressing and immediate challenges in the here and now. We are further blessed to have creative and innovative research minds in our midst, who, when supported with the proper resources, are capable of helping solve

"Our recently completed economic impact analysis of work undertaken by Genome Prairie funded researchers over the past 10 years confirmed a return of $5 for every dollar invested. This is why we have put an ambitious proposal for enhanced investment before the federal government to amplify the impact and outcome ..."

the challenges we face today using the very best genomics tools, techniques and processes the world has to offer.

So what are some of these great challenges of today? In the area of agriculture, a changing climate that may impact our ability to successfully and sustainably produce food means we need to understand and influence our natural environment in ways that only genomics is capable of doing with the requisite speed, cost and efficiency. In addition to the current work undertaken on wheat, lentils, cattle and bison, new work will soon be underway on crop rotations, the soil microbiome and natural grasslands. In all of these areas the intention is to bring impact today, not some far distant future.

In the human health space, immediate impact is being felt by the work underway through the Canadian Prairie Metabolic network, where new diagnostic tests have been developed to more rapidly diagnose and subsequently treat inborn errors in metabolism. Work will soon get underway to develop better and faster diagnostic tests for the helicobacter virus and breast cancer. Faster diagnostics results in better patient outcomes at less cost. This is indeed meeting the challenges of today.

In the natural environment space, we are not waiting around for an oil spill to happen in arctic waters. We are proactively developing and preparing, together with the inhabitants of the north, the deployment of the genomic tools and techniques to help monitor and mitigate the consequence of an oil spill.

While this work brings great benefit to the people of Canada, it is not without cost. The investments made at the federal, provincial and private sector level to bring about desirable impact and outcome continues to be well rewarded. Our recently completed economic impact analysis of work undertaken by Genome Prairie funded researchers over the past 10 years confirmed a return of $5 for every dollar invested. This is why we have put an ambitious proposal for enhanced investment before the federal government to amplify the impact and outcome, not in some distant future, but today, in the here and now.

We are humbled to be able to play a key role in this ecosystem and understand our responsibilities to stakeholders and the people of Manitoba, Saskatchewan and across Canada well. We will continue to bring the very best effort, thinking and creativity forward in the coming years to help solve the challenges of today, whatever that today may be.

ANNUAL MESSAGE FROM THE CHIEF SCIENTIFIC OFFICER

DR. LESTER YOUNG

In a testament to the world-

leading expertise of our regional scientists and strategic investments from our partners, the Genome Prairie community had marked success in the 2022 $70M Climate Smart Agriculture and Food Systems (CSAFS) Initiative. Genome Prairie will serve as the lead Centre on three of the nine approved research projects (ACTIVATE, BENEFIT, GG4GHG), co-lead the PeaCE project with Genome Alberta, and co-lead the flagship KMIC Hub with Genome BC and Ontario Genomics. In addition to the CSAFS Initiative, we added two new projects to our health portfolio in 2022, one examining Helicobacter treatment and the other addressing ovarian cancer. These projects are all described within this Annual report.

Our programs team intends to build on its successes in our region over the next year with several new opportunities on the horizon. The Cooperation, Collaboration and Community (C3) Hub and the regional project of Genomic Monitoring of Pathogens in Water (GeMPaW) will soon be launched. We will then see a streamlined GAPP application process appear for Round 27 in Spring 2024. And a Precision Health funding opportunity will become available in Fall 2024.

Our programs team looks forward to working with health and environment researchers and receptor organizations within our region on these new

"I am proud of the activities Genome Prairie, and our community have undertaken over the past year to answer the challenges we now face in Canadian agriculture, health and our environment."

initiatives while continuing to assist ongoing projects such as the Genome Prairie-led 4DWHEAT, EVOLVES, GENICE II and Genomic ASSETS, the co-led GenFISH project and, the All For One rare disease project (CPMN). Advances in these projects shared through papers, presentations, and information provided to data hubs, continue to address research questions of national economic importance and establish Canada's leadership in key areas.

As new projects join our portfolio of active research projects, others begin to wrap up. We are starting to see the impact that CORGI, COV3R, FLOWTR and TACSI will have in our communities and the differences they are making to the way the end-users approach and utilize genomics.

The ongoing success of these projects is easily attributable to growing connections and investments from the Universities of Manitoba, Regina and Saskatchewan, the agriculture, economic development and health Ministries in both Provinces, and other partners, such as MCA, RDAR, the Saskatchewan Health Authority, SaskPulse, SaskWheat, Shared Health Manitoba and, WGRF, all who have provided significant investment into critical research projects in Manitoba and Saskatchewan. With their commitment and ongoing support, world-calibre genomics researchers and research groups in our region can access Genome Canada funding, expand their research in important areas, and keep the Prairies at the forefront of genomics research in agriculture, health and the environment.

Over the past year, I worked extensively with Genome Canada and the other Genome Centers across Canada at programmatic and strategic levels, for example, formulating program directions for CSAFS, GAPP and the upcoming GeMPaW and Precision Health programs. I also participated in Genome Canada's discussion of its future directions and response to the role of genomics in Canada's biodiversity strategy.

I am proud of the activities Genome Prairie, and our community have undertaken over the past year to answer the challenges we now face in Canadian agriculture, health and our environment. Over the next year, I look forward to encouraging -omics research and development within Manitoba and Saskatchewan and seeing the genomics projects we support continue to have a genuine positive impact in our region.

MANAGEMENT & ADMINISTRATION

Mike Cey, PAg, EMBA
President & CEO

Patrick Pitka, FCPA, FCA, Pro.dir
Chief Financial Officer (CFO)

Dr. Lester Young, PhD
Chief Scientific Officer (CSO)

Dr. Jerlene Halliday, PhD
Manager, Sector Innovation

Jelene Pugoy (B.Env.D)
Program Coordinator

Dr. Ifeoma Okwor, DVM, PhD
Manager, Programs

Oyewole Oyebanji, MSc, CA, CIFC
Senior Accountant

Tony Bassett, BA, MA
Manager, Communications and Stakeholder Relations

Faye Pagdonsolan
Senior Manager, Administration & Board Relations

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2022-23
GENOME PRAIRIE PROJECTS

4DWheat

Project Leader(s): Dr. Curtis Pozniak (University of Saskatchewan), Dr. Sylvie Cloutier (Agriculture and Agri-Food Canada)
Project Manager: Raelene Regier
Project Value: $11.2 million
Genome Canada Contribution: $4.0 million

AGRICULTURE & FOOD SYSTEMS GENOMICS CHALLENGE

Launched in 2019 and now entering the final stages of its research, the 4DWheat project continues its work to tackle two main challenges facing Canadian grain producers: finding ways of developing breeds that respond to environmental conditions (drought, moisture), and combating diseases which can impact annual crop yields. With world population growth exceeding yield improvement gains, global food supply shortages could become a significant problem by the middle of this century.

4DWheat's mandate is focused on using cutting-edge genomics in capturing diversity in wheat breeding towards "harnessing Diversity, advancing Domestication, enabling Discovery and expediting Delivery." Among the project's enterprising objectives, the past year saw much progress in

sequencing wild strains of the wheat genome to help identify traits which could lead to more robust and productive crops.

"Accessing and understanding genetic variability which exists in wild relatives marks a significant step towards developing genomic tools that would be used to transfer useful genes into elite germplasm," said Dr. Curtis Pozniak, project co-lead and professor at the University of Saskatchewan's Crop Development Centre.

"The focus of the sequencing activities was to develop an understanding of genome structures, understand the genes that are there, and more importantly, the variability that's associated with those genes that could be targeted in breeding programs where we're breeding desirable genes from the wild relatives," said Pozniak.

"This part of the project has progressed very well. We've primarily completed the sequencing and are well into the comparative analysis."

Another major project activity this year was harnessing the genetic diversity of wild relatives by using a novel approach relating to gene editing.

"We recognize wild relatives, although they carry useful genes relating to disease and drought stress, using that material in breeding is a very cumbersome process, largely because these wild relatives are associated with drawbacks as they shatter, they don't flower on time and other drawbacks.

"Our strategy has been to use gene editing to fix these negative traits so we can domesticate these wild relatives so they can be used more efficiently. "This was an ambitious activity. We first had to develop protocols to allow for the editing of genes of wild relatives. We're now at the stage of looking at how to deploy these advances in the context of a plant breeding program."

As 4DWheat moves forward (it is scheduled to wrap up much of its activities in the coming months), Pozniak said the science of genomics will play an important role in meeting the challenge of ensuring the world in the future has ample food supplies. "Food security requires an integrated toolbox, from basic research to the development of commercial varieties. Our strategy of using genomic technologies to identify genes that will be important to protecting crops and advancing yield productivity in the stressful western Canadian environment.

"Our strategy of using genomic technologies to identify genes that will be important to protecting crops and advancing yield productivity in the stressful western Canadian environment."

DR. CURTIS POZNIAK

"We've already identified and cloned several useful disease-resistant strains – many are not that far away from yield testing for commercial production. "This is an ongoing process of incremental steps. In plant breeding, there's never a finish line. It's always about improving."

4DWheat Project Funding Partners: Canadian Wheat Research Coalition, Western Grain Research Foundation, Saskatchewan Wheat Development Commission, Alberta Wheat Development Commission, Manitoba Barley and Wheat Development Commission, Government of Saskatchewan, AAFC Partnership, Viterra, Illumina, Ontario Ministry of Economic Development, Job Creation & Trade (MEDJCT).

Genomic Antimicrobial Stewardship Systems for Evidence-Based Treatment Strategies (ASSETS) for Livestock

Project Leader(s): Dr. Cheryl Waldner (University of Saskatchewan), Dr. Simon Otto (University of Alberta).
Project Manager: Lianne McLeod
Project Value: $5.7 million
Genome Canada Contribution: $2.5 million

ANIMAL HEALTH GENOMICS CHALLENGE

The threat of bacteria becoming resistant to antibiotics are a rapidly growing threat to the Canadian livestock industry. According to research published by the Beef Cattle Research Council, the spread of infectious diseases like Bovine Respiratory Disease (BRD) account for 65-80% of sickness and 45%-70% of deaths in some feedlots. The council estimates that over three-quarters of Canadian feedlots have treated at least one calf for a respiratory infection.

Infection and premature deaths are impacting an industry with an estimated 60,000 farms that generate more than $20 billion for the Canadian economy each year. In 2019, Genome Prairie helped launch the Genomic ASSETS project, whose focus has been on developing genomic-based diagnostic tools and respiratory vaccines to reduce disease spread. In a recent interview, project academic lead Dr. Cheryl Waldner said the ASSETS project also hopes to reduce

the use of antibiotics on the farm to reduce the rise and rise of bacterial resistance to these therapies.

"In the feedlots, antibiotics are crucial for controlling disease progression because, untreated, bovine respiratory disease can have severe health and welfare impacts. By identifying bacteria and viruses in cattle arriving at feedlots, we can improve vaccination and disease management recommendations and reduce the risk of respiratory disease and the need for antimicrobial treatment," said Waldner.

Since the project began and over the past year, The ASSETS project, said Waldner, is examining two different diagnostic tools, one of which leverages a "metagenomics" approach to help better identify individual calves who are infected. Unlike conventional (i.e., current) testing, where laboratories look for particular bacteria or viruses, the metagenomics approach provides a more panoramic view of infection.

"Metagenomics casts a fishing net versus using a single line and hook to identify information on infectious organisms. It's not an individual organism that we're looking for with this test. With our approach, we've cast a very broad net to describe the genomic material we recover from samples.

"The genomic material tells us not just what bacteria are there, but also crucially identifies antimicrobial resistance genes and specific strains of bacteria more likely to cause severe disease," said Waldner. "We can also test for a whole suite of viruses with slight modifications to the protocol for processing samples. This gets us much closer to a one-test approach to find out what is causing a problem and how to best manage it, rather than having to know ahead of time what you're testing for."

As the project winds down in the months ahead, with countless pathogen DNA samples taken from calves, Waldner says that the results of collaborative field studies of these new tools will be in the hands of feedlot veterinarians before this summer.

"We will continue to work with our partnering veterinary clinics and get their feedback on how to make the best possible use of these new technologies."

Genomic ASSETS Project Funding Partners: Province of Saskatchewan, Feedlot Health Management Services, Agriculture and Agri-Food Canada, Alberta Agricultural & Forestry, University of Saskatchewan, Western College of Veterinary Medicine, University of Alberta, Saskatchewan Cattlemen's Association, Alberta Beef Producers.

Bison cows and their calves at the University of Saskatchewan's Livestock and Forage Centre of Excellence.
Source: Christina Weese

The Bison Integrated Genomics (BIG) Project (2022-25)

Project Leader(s): Dr. Gregg Adams (University of Saskatchewan)
Receptor Leader: Dr. Toddy K. Shury (Parks Canada Agency)
Project Value: $5.2 million
Genome Canada Contribution: $1.68 million

BIODIVERSITY & ENVIRONMENT GENOMICS CHALLENGE

A wicked problem. Disease, depleted herd populations and a lack of genetic diversity. That's the multi-faceted challenge facing Canada's wild wood bison population. Depopulation from decades of hunting and the spread of respiratory pathogens has pushed the bison to the brink of extinction. The small surviving numbers also present another big challenge – a lack of genetic diversity among herds, creating increased vulnerability to the spread of disease.

Since its launch in July 2022, the Bison Integrated Genomics (or BIG Project) has made significant progress in working towards two primary objectives to solve this wicked challenge. Firstly, in developing a vaccine to tackle the spread of brucella and tuberculosis pathogens. Dr. Todd Shury, BIG Project receptor lead and researcher with Parks Canada Agency, indicated that collaboration between researchers and museums across North America has also resulted in much progress toward creating enhanced genetic diversity among wood bison populations.

"We've been working with archeologists and museums all across Canada collecting bison bone samples and done genome sequencing on samples ranging from 3,000 to about 100,000 years old," said Shury.

"We've already discovered that there wasn't much difference in their genetic structure until about 3,000 years ago when they split into planes and wood bison subspecies." Shury and the project team will use the sequenced materials from these ancient samplings

A wood bison calf at the University of Saskatchewan's Livestock and Forage Centre of Excellence.
Source: Caitlin Taylor

and integrate the materials into existing herds to increase the population's genetic strength and diversity.

Shury said the genetic information collected will dovetail into the project's continuing work on a "SNP" chip (the SNP stands for single nucleotide polymorphism, which helps to identify specific traits). The SNP chip will enable researchers to differentiate between plains and wood bison subspecies and identify bison with evidence of cattle genetic introgression (cattle genetic signatures that have become incorporated into the bison genome through cross-breeding).

"Knowing what we know now through the genome sequencing, we want to develop the SNP chip so we can go into herds and look at how much introgression has occurred between the plains bison and cattle. We're hoping to have the SNP chip fully developed in the coming months to differentiate plains and wood bison very effectively."

A key component of the BIG project is sharing genetic information collected with indigenous groups. Shury said that much progress was made with the assistance of the Toronto Zoo, a project partner.

"The Toronto Zoo has been instrumental this year for the governance of this biobank. We've been having multiple meetings with indigenous groups around Wood Buffalo National Park since the project started, about 13 different groups," said Shury. "These groups want to be directly involved in managing these genomic samples and developing a solid governance framework before we go out into the field and collect samples from some of those herds. We want to ensure that good access and benefit-sharing agreements are in place."

In addition to understanding the bison's genetic diversity and its collaborations with indigenous peoples, Shury indicated that much progress has been made in developing vaccines for brucella and tuberculosis. "We have eight vaccine candidates developed, and we aim to do an experimental trial with selected bison calves this winter. We hope to have the eight narrowed down to one vaccine candidate."

The BIG Project is scheduled to complete its data collection and research by 2026.

BIG Project Partners: Agriculture and Agri-Food Canada, University of Alberta, The Toronto Zoo.

CPMN – The Canadian Prairie Metabolic Network

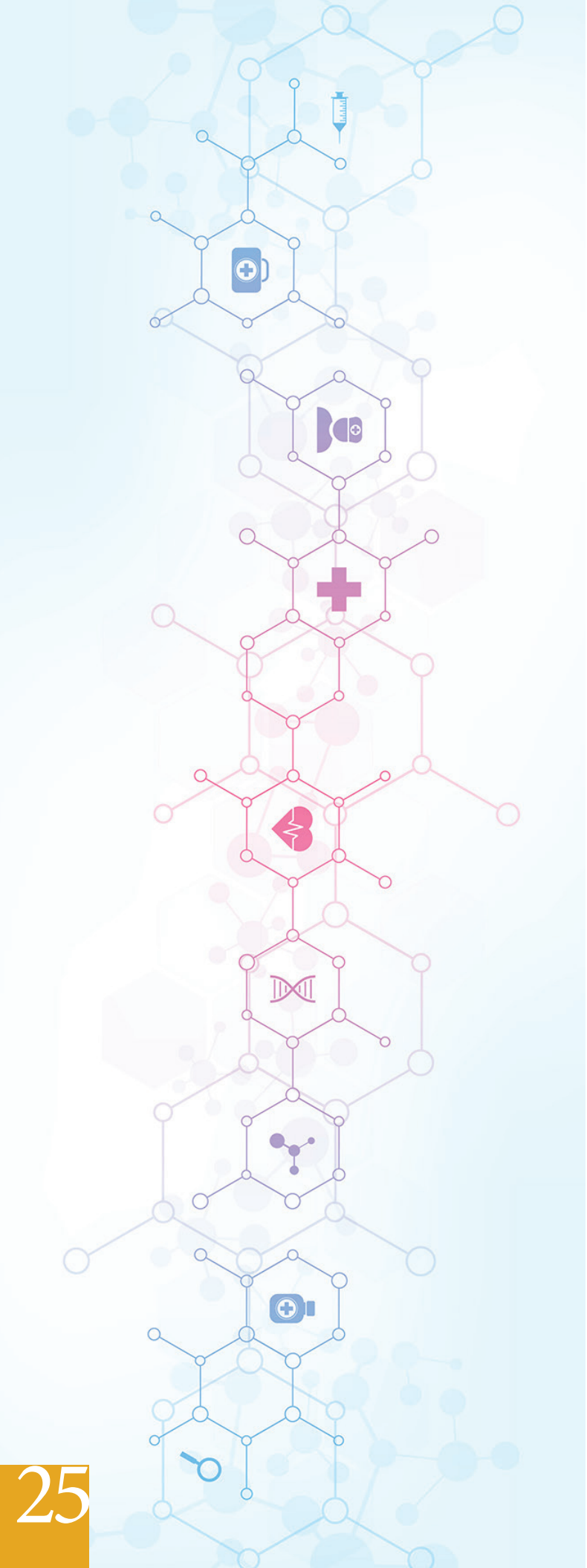
Project Leader: Cheryl Rockman-Greenberg
Receptor Leader: Petr Kresta, Shared Health Manitoba
Project Value: $6.1 million
Genome Canada Contribution: $2.0 million

HUMAN HEALTH
GENOMICS CHALLENGE

Identifying and providing effective therapies for individuals with rare genetic conditions is one of Canadian health professionals' most difficult challenges. Rare diseases like inborn errors in metabolism (IEMs) form the foundation of work by the Canadian Prairie Metabolic Network, whose research over the past year has resulted in numerous diagnoses and positive impacts for families in the prairies.

"We have had over 200 referrals since the project was started, and we have results from over 100 patients," said CPMN project lead Dr. Cheryl-Rockman Greenberg. "As far as diagnostic terms, we've found DNA variants in about 22% of the referrals that are likely the cause of patient symptoms."

Rare genetic conditions are particularly difficult for health professionals because they can be difficult to diagnose. Common early symptoms are sometimes misidentified as they overlap with the signs and symptoms of much more common disorders (such as the flu). Spotting rare genetic conditions is even more difficult in young patients, especially newborns.



" ... we've been able to have the patient avoid long and often protracted delays, especially letting them be heard. So patient satisfaction is very high."

DR. CHERYL ROCKMAN-GREENBERG

"We have also found in about 50% of tested patients that they have VUS, a variant of uncertain significance. This rate was a bit higher than we anticipated. We don't know right now if the variants we found are the cause of the patient's problems. Still, it also leads us into our next research stage, which will be to investigate which VUSs should be investigated to clarify whether they are disease-causing or not."

"We've learnt that although the CPMN project was to study the cause of suspected metabolic problems, there's a lot of overlap in the signs and symptoms between diseases and general genetics," said Rockman-Greenberg. "For example, we've identified both metabolic and non-metabolic causes, even though we were just looking for metabolic causes. That's because a lot of the symptoms are non-specific.

"So, moving forward, our inclusion criteria for testing will go beyond inherited metabolic disease – because there's a lot of overlap between inherited metabolic disease and other genetic disorders."

Beyond the testing results received so far, Rockman-Greenberg said one of the most significant impacts of the CPMN project is how it helped to bring answers to patients seeking answers for their conditions. "We've found in our first year, regardless of whether we have made a precise diagnosis, we've been able to have the patient avoid long and often protracted delays, especially letting them be heard. So patient satisfaction is very high."

CPMN Project Partners: Shared Health Manitoba, Discovery DNA.

The original COV3R team: Dr. Keith MacKenzie, Dr. Kara Loos, Dr. Andrew Cameron and Danae Suchen.
Source: University of Regina Photography

COVID-19 Rapid Regional Response (COV3R) Project

Project Leader: Dr. Andrew Cameron (University of Regina), Dr. David Alexander (University of Manitoba).
Project Value: $478,000
Genome Canada Contribution: $250,000

HUMAN HEALTH
GENOMICS CHALLENGE

From the start of the SARS-COVID-2 pandemic in 2020, the COV3R (COVID-19 Rapid Regional Response) project has focused on the challenge of accurately detecting co-infections in humans. The project has also worked on developing better ways and means of more efficiently and effectively detecting pathogens and bacteria that could harm the general public.

"The COV3R projects is just as much about diagnostics as it is about surveillance," said project lead Dr. Andrew Cameron in a recent interview. "When the project began in 2020, it was looking to detect and genotype SARS-COVID 2 and any Co-infecting viruses. We knew then of the great potential for expensive genomic technologies to improve not just diagnostics but also surveillance, to genotype all sorts of things circulating in the general population that we might not even know about."

Since its beginnings in 2020, the COV3R project team has been working on finding an effective "middle ground" for genomics-based testing and surveillance. Currently, there are approaches ranging from PCR

"One of the things the team is most proud of is developing a novel strategy to capture and genotype bacteria ..."

DR. ANDREW CAMERON

testing (precise diagnosis for an individual patient) to a more "shotgun" approach called metagenomics (a wide array of data taken from a large sampling pool). Instead, the COV3R team has developed a "probe capture enrichment" approach that can detect a multitude of viruses, either known or unknown.

"Shotgun metagenomics is still a very academic pursuit," said Cameron. "It can generate massive amounts of data, and it takes a long time to diagnose.

"Capture enrichment offers big advantages is that it essentially takes the power of shotgun metagenomics and deploys it in a way that is both rapid and sensitive, but most importantly, it generates data that can be made into a diagnostic and be interpreted by folks in public health labs."

"False positives are a tricky issue. Diagnostics can be tricky. Health officials need validation to know if a test result is true positive or negative. Genomics, even though it's powerful, can sometimes be messy. It samples massive amounts of biological diversity, so making sense of a sample can be challenging.

"Over the past year, we've moved further in figuring out how sensitive probe capture enrichment is, how we can retool it to make it more sensitive, and how can we make sure to capture pathogens we know or don't know are there.

"We've been working with very diverse sample types. We started with nasal swabs like the ones used for COVID testing, which work great. We moved into other areas like bodily fluids and organ tissues, and now we're getting into wastewater samples," said Cameron.

Another significant project achievement from the past year was developing a process for custom diagnostics and analysis design. Cameron said custom processes would be critical to aid public health and laboratories in conducting tests on viruses and bacteria that threaten human health.

"One thing that has been so obvious to us right from the beginning of this project is the immense benefits of working with our partners in developing doing custom process instead of buying one through a 3rd party vendor. The vendors know we're making better processes because we've been able to show that the vendors have failed to detect some of the most common viruses.

"It's better to design our own because we know what we want to do. Better yet, we can make it to fit the need," said Cameron.

"One of the things the team is most proud of is developing a novel strategy to capture and genotype bacteria, which vendors have shied away from bacteria because it's harder. There's greater diversity. Their genomes are greater. So, we've developed a new way to detect and genotype bacteria effectively."

The COV3R project is scheduled to complete its project research by 2024.

COV3R Project Partners: Saskatchewan Health Research Foundation, British Columbia Centre for Disease Control, Roy Romanow Provincial Laboratory, Cadham Provincial Laboratory, Natural Sciences and Research Council of Canada (NSERC), Institute for Microbial Systems and Society (IMSS).

EVOLVES – Enhancing the Value of Lentil Variation for Ecosystem Survival

Project Leader(s): Dr. Kirstin Bett (University of Saskatchewan), Dr. Albert Vanderberg (University of Saskatchewan)
Project Manager: Laura Jardine (University of Saskatchewan) Project Manager, evolves project.
Project Value: $7.4 million
Genome Canada Contribution: $3.5 million

AGRICULTURE & FOOD SYSTEMS GENOMICS CHALLENGE

The EVOLVES (Enhancing the Value of Lentil Variation for Ecosystem Survival) project aims to improve cultivated and wild lentils' genetic variability, phenotyping, and gene sequencing. EVOLVES takes an 'omics (combining genomics and phenomics) approach so traits highly valued by exporters can be "zeroed in on" to produce specific varieties. This approach could produce lentil crops with a particular colour, size, taste, or nutritional value.

Since its launch in 2019, the EVOLVES team has been focused on improving lentils' nutritional and cosmetic traits to help Canadian producers maintain a competitive edge in securing higher-end consumers within the global commodity market.

"Countries like Kazakhstan are poised to undercut Canada's exporters," said project lead Dr. Kristin Bett in a recent interview. "So, we have to get out ahead of that by having better genetics. One way

is to diversify what we produce to go after the premium markets."

The main focus areas are improving the nutritional value (inside the lentil seed) and external appearance (the outer coating) to make them more attractive as premium consumables. In a recent interview, EVOLVES project manager Laura Jardine said significant progress had been made in the past year.

"We are about 90% complete in our nutritional analysis, and colour has some more work to be done in the coming months," said Jardine. We have wild lentils profiled for B vitamins, amino acids, and protein levels. This was a big part of the project, and at this stage, we have a large B Vitamin profile ready for publication," said Jardine. "We also have mineral profiling from all the lentil varieties we studied at the Crop Development Centre. We've also made great progress in profiling amino acids and proteins, and we hope to be publishing findings soon."

"On the outside of the lentil, we have shape and seed colour characteristics work that is wrapping up. Results from shape analysis and colour characteristics should also be available soon," said Jardine.

As the project winds down towards completing its research activities in 2024, Jardine said the remaining work will be focused on data collection from its final field trials.

"Our biggest secret weapon on this project has been data management. We have a huge pool of data that's incredibly well organized and stored so that it can be used again," said Jardine. So, we can have people re-examine the genome data months or years from now and mine it for information."

"EVOLVES will set the CDC breeding program up to create better varieties in the future with more nutritional value and better appearance. What we hope to have at the end of EVOLVES is a breeder's manual that says, 'You can do this if you want this, so use these genomics lines, or avoid these lines.'"

EVOLVES Project Partners: Western Grains Research Foundation, Saskatchewan Pulse Growers, BASF, University of Saskatchewan, Global Institute for Food Security, Marche Polytechnic University (Italy), Palacky University Olomouc (Czech Republic), AGT Food and Ingredients.

An engineered floating wetland designed by the FLOWTER project team to remediate oil contaminants.
Source: Madeline Stanley, International Insitutue for Sustainable Development

FLOWTER (Floating Wetland Treatments to Enhance Remediation)

Project Leader: Dr. Vince Palace (IISD-Experimental Lakes Area)
Receptor Leader: Patrick Smyth (Canadian Association of Petroleum Producers)
Project Value: $3.9 million
Genome Canada Contribution: $1.1 million

Now in its final project stages, the FLOWTER project continued to advance its innovative approach in developing a cost-effective solution for remediating fuel spills in fragile freshwater lakes. The solution is genetically modified floating wetlands that can be easily deployed along lake shorelines contaminated by spillage.

BIODIVERSITY & ENVIRONMENT GENOMICS CHALLENGE

In a recent interview, the FLOWTER project lead, Dr. Vince Palace said the FLOWTER project combines the power of genome sequencing with a biological-based approach toward degrading oil in fragile shoreline environments. A major focus of the project has been how microorganisms act and interact with oil contamination.

An example of freshwater source with oil contamination.
Source: IISD-Experimental Lakes Area

"When we started, the project asked the basic question, 'Does the microbial community change when exposed to oil?' The answer we know now is yes. 'Are there bacteria in the system capable of degrading the oil?' We also know the answer to this question is yes," said Palace.

The FLOWTER team's innovative solution to the circulation challenge was developing floating engineered wetlands placed along shorelines. These floating vegetation pods act as nurturing homes to microorganisms as they go about "eating" up the oil.

"You have these floating platforms of vegetation, and underneath those platforms are very large root networks," said Palace. "The roots provide an enormous surface area for bacteria to grow on with a big circulation of oxygen, nutrients, and the oil itself.

"The bacteria on the roots receive oxygen being pushed down by plants to their roots, while at the same time, the bacteria work to break down the oil. "We are not adding microbes. We are not adding bacteria to the environment. We are simply stimulating the bacteria that are there already."

Now in its final months of testing, Palace is hoping the project's innovation could have application to protecting other vulnerable water sources.

The FLOWTER project is expected to wrap up its research activities in 2023.

FLOWTER Project Partners: IISD-Experimental Lakes Area, Canadian Association of Petroleum Producers, Canadian Energy Pipeline Association, Natural Resources Canada, Mitacs, Trans Mountain Corporation, Myera Group Inc., Jacor LLC, Stantec Inc., TransCanada Pipeline, Enbridge Inc., National Energy Board, Polaris Applied Sciences, Martin Ecosystems.

The Churchill Marine Observatory in Churchill, Manitoba.
Source: University of Manitoba

GENICE II (Genomic Solutions for Natural Resources and the Environment)

Project Leader(s): Dr. Gary Stern, Dr. Eric Collins (University of Manitoba)
Project Value: $6.4 million
Genome Canada Contribution: $2.9 million

BIODIVERSITY & ENVIRONMENT GENOMICS CHALLENGE

The continuing rise of global temperatures caused by climate change is not only posing a threat to Canada's expansive environment, but also changing the landscape and how humans navigate. The warming atmosphere has seen some of its greatest impacts in the world's most remote and coldest areas, including Canada's Artic region. Once considered impassible for much of the year, the relentless melting of snow and ice has opened Canada's Northwest Passage to ships traveling from Europe and Africa to eastern Asia (and vise versa). Traveling through the Northwest passage means ships can travel dramatically shorter distances than via the Panama Canal.

High volumes of shipping traffic are projected to create a growing challenge – the threat of oil and fuel spills from increased traffic on the pristine Arctic shorelines. Through projects like GENICE II, Genome Prairie is meeting the challenge of gaining a greater understanding on how contaminations from spills affect shores in sea ice conditions. Researchers in Manitoba are developing hand-held genomic tools to monitor how microbials in sea ice conditions break down fuel contaminants.

The University of Manitoba's Dr. Gary Stern, GENICE II project lead, said the project, while delayed by construction of testing pools in Churchill, Manitoba,

The OSIM pool inside the curved dome of the Churchill Marine Observatory.
Source: University of Manitoba

has still progressed since the project launch in 2022.

"We were unable to supply the large test pools in Churchill with sea water on schedule, so instead we built smaller-sized pools to kickstart data generation," said Stern. The improvised pools have allowed project researchers to start gathering preliminary data that will help refine the development of genomics-based monitoring tools. These tools will then be used to determine how naturally occurring microbials break down carbon-based fuel spills in sea ice conditions.

The other major objective of the GENICE II project is working collaboratively with individuals and communities in the Arctic region in building collaborative relationships. The project aims to hire local residents to oversee the monitoring and data collection process.

Since its launch, according to Stern, members of the project team have held in-person meetings to discuss the project's objectives, and foster collaborative relationships.

"We held a workshop with three members of the Aqigiq and three Inuit guardians from the Foxe Basin Kivalliq North Sapujiyiit Guardians of the Sea Society towards developing a community-based monitoring framework," said Stern. "We've formed a good partnership with the society. They will work with Chesterfield Inlet, Coral Harbour, and Naujaat toward the goal of protecting the waters, marine mammals, and Inuit living in the Kivalliq region. The society will work towards developing an Inuit guardian program and hire Inuit youth researchers.

"We also identified eight different sites in the region for potential monitoring including freshwater lakes, rivers and marine sites."

"We've made great progress in working on developing Arctic community partnerships," said Stern.

"After getting ethics approval from the University of Manitoba, members of the team organized a community meeting in Chesterfield Inlet [Iqaluit] where the project was discussed with residents.

As the GENICE II project progresses, the research team will continue its engagement with Indigenous communities in the high Arctic region and further develop its genomics monitoring tools. The project is due to finish its work by the year 2025.

H. pylori under the microscope.
Source: Robinson et al 2016 Neuro-Immuno-Gastroenterology, supplied by Aleisha Reimer, National Microbiology Laboratory.

Helicobacter pylori Genomics Project

Project Leader: Dr. David C. Alexander (Cadham Provincial Laboratory),
Receptor Leader(s): Dr. Aleisha Reimer (Public Health Agency of Canada), Dr. Sara Christianson (Public Health Agency of Canada)
Project Value: $1.7 million
Genome Canada Contribution: $400,000

HUMAN HEALTH GENOMICS CHALLENGE

The Helicobacter pylori Genomics project (H. pylori), announced in March of 2023, is funded through Genome Canada's Genomic Applications Partnership Program (GAPP), which supports research and development projects that address real-world opportunities.

H. pylori is the leading cause of peptic ulcers and is considered one of the leading risk factors for gastric cancer. Approximately one out of every three Canadiens are infected with H. pylori (nearly half of the world's human population is infected). One of the more significant challenges with H. pylori is

An H. pylori antimicrobial cocktail.
Source: Aleisha Reimer, National Microbiology Laboratory.

accurately diagnosing the infection and identifying the most effective antimicrobial treatments. Currently, most individuals diagnosed with ulcer-causing H. pylori are provided with a cocktail of antimicrobial therapies, which can lead to increased antibiotic resistance.

The cocktail of drugs used to treat H. pylori usually involves a combination of antibiotics, proton pump inhibitors, and other medications to eradicate the infection and promote the healing of the affected tissues. However, the effectiveness of these drugs is unpredictable, mainly because knowledge about each individual's H. pylori infection is currently not determined. "Four to six antibiotics are used to fight H. pylori. Most of the time, the treatment is successful, but for about 30% of patients, antibiotics won't work, and then you have a problem."

Dr. David Alexander leads the project from the Cadham Provincial Laboratory in Winnipeg, Manitoba. The H. pylori Genomics Project aims to develop an end-to-end metagenomics-based pipeline to identify infections while creating a reference database of antimicrobial resistance. The major impacts of the project include more accurate diagnostics, increased rates of success for treatments, and a decrease in antimicrobial resistance. The ultimate impact of this project will be to reduce the significant social and economic burden of H. pylori on Canadians.

Alexander indicated the project would focus its lab research using a metagenomics approach in analyzing biopsy and stool samples.

"Where this project will push boundaries is how DNA samples are prepared to maximize what we can sequence," said Alexander. "We're tweaking our approach with the aim of finding a better way of sequencing more of the H. pylori and less of the stuff we are not interested in.

"We're looking at a couple of different approaches. One is the shotgun metagenomics approach, which means we just sequencing everything.

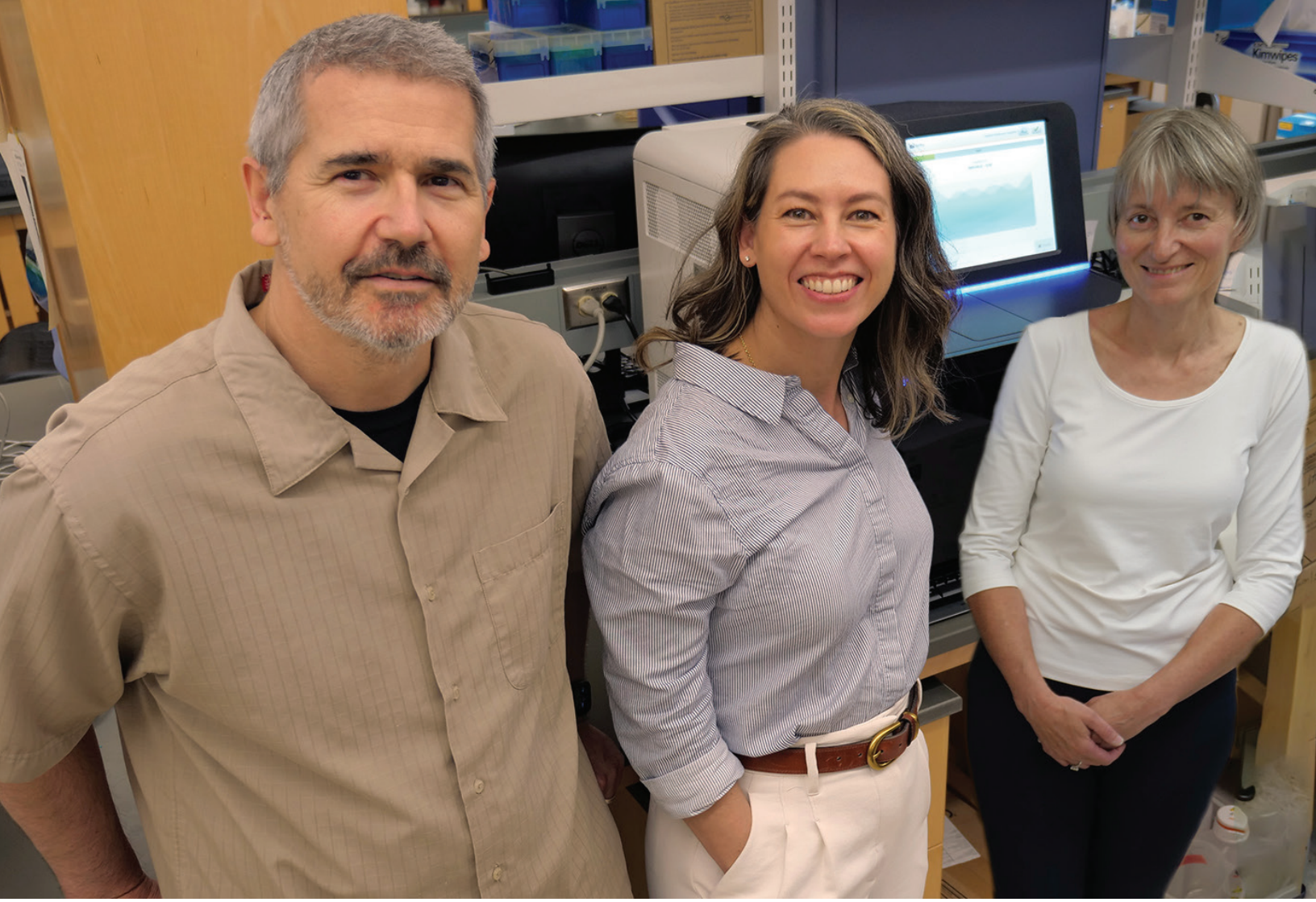
"The other is a sample preparation approach called bait capture. The goal is to capture pieces of H. pylori DNA relative to other stuff. For example, we may use a more traditional targeted PCR [Polymerase Chain Reaction – a way of amplifying small pieces of DNA] to identify only the most meaningful pieces of H. pylori DNA. Specifically, the ones that provide information about a strain's antibiotic resistance."

Presently, the most accurate way to diagnose an H. pylori infection involves endoscopy (a procedure to look inside the body) to visualize the stomach lining and obtain a biopsy for culture and antimicrobial resistance testing. Other methods, such as breath, stool, or blood tests, are unreliable and currently don't allow for antimicrobial resistance testing.

"We're trying to drag H. pylori testing into the 21st century," said Alexander in a recent interview. Infectious diseases, including H. pylori, have long fascinated Alexander, whose involvement in this area of research extends back more than three decades. "We want to address the gaps in how H. pylori is diagnosed and treatment decisions made."

The Helicobacter pylori genomics project is scheduled to run until 2026.

Helicobacter pylori Genomics Project Partners: National Microbiology Laboratory, Cadham Provincial Laboratory.



Ovarian Cancer project team members Dr. John DeCoteau, Mary Kinloch and Dr. Laura Hopkins.
Source: Daniel Hallen

Ovarian Cancer Genomics Project

Project Leader: Dr. John DeCoteau (University of Saskatchewan).
Receptor Leader: Dr. Mary Kinloch (Saskatchewan Health Authority).
Project Value: $1.7 million
Genome Canada Contribution: $1.1 million

Ovarian cancer is an aggressive disease that is diagnosed in thousands of Canadian women on an annual basis. Ovarian cancer has a high mortality rate, with only 50% of diagnosed women surviving beyond six years. A major contributing factor to high mortality rates is that the diagnosis frequently occurs at an advanced stage of the disease, mainly because detection is difficult.

Genome Prairie's Ovarian Cancer Genomics Project, announced in March of 2023, is working to meet the challenge of ovarian cancer by refining the diagnostic process toward using more effective therapies to battle the disease. The sought outcomes from this project – an increase in positive treatment outcomes

HUMAN HEALTH
GENOMICS CHALLENGE

> ***"I believe the lessons we learn from this project could apply to other groups and could be revolutionary for ovarian cancer and other cancer research."***
>
> ***DR. MARY KINLOCH***

and longer lives for those afflicted by the disease.

One of the key focuses of the project will be to identify diagnosed patients via DNA sequencing who are homologous recombination (HR) deficient, meaning they could be responsive to drugs called PARP inhibitors. Current diagnostics have been able to identify approximately one-in-four patients as HR-deficient. However, project receptor lead Dr. Mary Kinloch, from the Saskatchewan Health Authority believes genomic testing could expand that number to one-in-two patients.

PARP inhibitors could result in more patients opting to use this more efficient treatment and fewer patients suffering side-effects from what is an ineffective chemotherapy agent for them.

"There's an unfortunate group of women that receive very toxic treatments. We're talking about the indiscriminate destruction of tumours and healthy cells, which can work," said Kinloch recently.

"Still, it also means healthy cells that line the stomach, all skin cells in the mouth, hair cells and bone marrow are all affected.

In addition to advancing diagnostics and treatments, the project will develop a database of individual patient tumour profiles that may assist health professionals in providing more effective treatments.

"One of the complicating factors is we currently compile information about patient tumours on a flat database which is just information," said Kinloch. "For this project, every patient we sequence will have a discrete data field, so everything will be relational instead of having a flat database.

"This is crucial because we can then understand how many are HR-deficient, how many are not, which mutations did they show, and, most importantly, how was their outcome. We have three years to show how having discrete data fields within a patient's file will provide better information and improve healthcare decisions. We want to extend this to other cancers, then."

There is much hope from Kinloch that advances made by the project team could lead to revolutionary treatments for other impactful cancers, including breast and prostate cancer: "I believe the lessons we learn from this project could apply to other groups and could be revolutionary for ovarian cancer and other cancer research."

The Ovarian Cancer Genomics Project is scheduled to run until 2026.

Ovarian Cancer Genomics Project Partners: University of Saskatchewan, Saskatchewan Cancer Agency, Ovarian Cancer Canada, Terry Fox Foundation

CURRENT PROJECTS OVERVIEW

PROJECT TITLE	SECTOR	LEADERS	ORGANIZATION(S)	FUNDING
GENICE II: Reimaging Monitored Natural Attenuation as an Oil Spil Response Strategy in the Arctic	Biodiversity & Environment	Stern, Gary Collins, Eric	University of Manitoba	$6,020,874
EVOLVES: Enhancing the Value of Lentil Variation for Ecosystem Survival	Agriculture	Bett, Kirstin, Vandenberg, Albert	University of Saskatchewan	$7,432,398
Genomic ASSETS (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) for Livestock	Agriculture	Waldner, Cheryl Otto, Simon	University of Saskatchewan, University of Alberta	$5,678,154
4DWheat: Diversity, Discovery, Design and Delivery	Agriculture	Pozniak, Curtis Cloutier, Sylvie	University of Saskatchewan, Agriculture and Agri-Food Canada	$11,166,747
GFG4GHG: Grassland Genomics Project	Biodiversity & Environment	Bennett, Jonathan, Asselin, Sean	University of Saskatchewan, Agriculture and Agri-Food Canada	$5,900,000
COV3R: COVID-19 Rapid Regional Response	Health	Cameron, Andrew Alexander, David	University of Regina, University of Manitoba	$478,000
Bio-inoculants and Crop Resiliency Project	Agriculture	Oresnik, Ivan diCenzo, Geroge	University of Manitoba, Queen's University	$6,150,000
ACTIVATing Genomics Project	Agriculture	Pozniak, Curtis Bett, Kirstin	University of Saskatchewan	$6,150,000
Heliocobacter pylori Genomics Project	Heath	Alexander, David Reimer, Aleisha	Cadham Provincial Laboratory, Public Health Agency of Canada	$1,650,000
Ovarian Cancer Genomics Project	Helath	DeCoteau, John Kinlcoh, Mary	University of Saskatchewan, Saskatchewan Health Agency	$2,027,496
Canadian Prairie Metabolic Network	Health	Rockman- Greenberg, Cheryl: Topp, Adam	University of Manitoba Shared Health	$6,068,618
FLOWTER: Floating Wetland Treatments to Enhance Remediation	Biodiversity & Environment	Palace, Vince Smyth, Patrick	IISD - Experimental Lakes Area, Canadian Association of Petroleum Producers	$3,905,267
BIG: Bison Integrated Genomics	Biodiversity & Environment	Adams, Gregg Shury, Todd	University of Saskatchewan, Parks Canada Agency	$1,680,000

GENOME PRAIRIE IMPACTS

2022-23 marked an active year for Genome Prairie in the community, and within the Canadian genomic enterprise. Here's just a few of this year's external highlights:

Genome Prairie continued its support of science in the classroom this year, sponsoring events like the Bison Regional Science Fair. Genome Prairie's Dr. Ifeoma Okwor joined the 2023 gold, silver and bronze award winners in Winnipeg. Manitoba.

Genome Prairie was the proud organizer for the Indigenous Voices in Science roundtable during the Canadian Global Biotech Week. Outreach and reconciliation with indigenous is a fundamental component of Genome Prairie's mission.

More than 300 delegates were on hand for Genome Prairie's announcement of the Bison Integrated Genomics Project (BIG) in Saskatoon. Promoting new projects and genomics innovations in Western Canada is of high priority for Genome Prairie's executive management and administration.

Nearly 100 elected officials, researchers and senior policymakers, including Manitoba Premier Heather Stefanson and members of the opposition, joined Genome Prarie for a celebration of genomics networking event held at the Legislative Assembly of Manitoba in March 2023.

Engaging and informing federal policymakers is vital for Canada's continuing growth of genomics research. Genome Prairie's CEO Mike Cey joined a Genome Canada-organized delegation at the Agri-Food Innovation Council spring engagement session held in Ottawa.

Genome Prairie cherishes its research partnerships, including Saskatchewan Polytechnique. Here, CEO Mike Cey announces the handover of two genomics sequencing systems to SaskPolytech to enhance program delivery at its BioScience Applied Research Centre. in September, 2022.

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Consolidated Financial Statements of

GENOME PRAIRIE

And Independent Auditors' Report thereon

Year ended March 31, 2023

INDEPENDENT AUDITORS' REPORT

To the Directors of Genome Prairie

Opinion

We have audited the consolidated financial statements of Genome Prairie (the Entity), which comprise:

- the consolidated statement of financial position as at March 31, 2023
- the consolidated statement of operations and changes in net assets for the year then ended
- the consolidated statement of cash flows for the year then ended
- and notes to the consolidated financial statements, including a summary of significant accounting policies

(Hereinafter referred to as the "financial statements").

In our opinion, the accompanying financial statements, present fairly, in all material respects, the consolidated financial position of the Entity as at March 31, 2023, and its consolidated results of operations and its consolidated cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Basis for Opinion

We conducted our audit in accordance with Canadian generally accepted auditing standards. Our responsibilities under those standards are further described in the "***Auditors' Responsibilities for the Audit of the Financial Statements***" section of our auditors' report.

We are independent of the Entity in accordance with the ethical requirements that are relevant to our audit of the financial statements in Canada and we have fulfilled our other ethical responsibilities in accordance with these requirements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Entity's ability to continue as a going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Entity or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Entity's financial reporting process.

Auditors' Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditors' report that includes our opinion.

Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with Canadian generally accepted auditing standards will always detect a material misstatement when it exists.

Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with Canadian generally accepted auditing standards, we exercise professional judgment and maintain professional skepticism throughout the audit.

We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion.

  The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Entity's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Entity's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditors' report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditors' report. However, future events or conditions may cause the Entity to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

- Communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the group Entity to express an opinion on the financial statements. We are responsible for the direction, supervision and performance of the group audit. We remain solely responsible for our audit opinion.

KPMG LLP

Chartered Professional Accountants
Saskatoon, Canada
July 4, 2023

GENOME PRAIRIE

Consolidated Statement of Financial Position

March 31, 2023, with comparative information for 2022

	2023	2022
Assets		
Current assets:		
Cash and cash equivalents	$ 5,018,137	$ 4,012,427
Accounts receivable	42,809	71,097
GST receivable	10,755	44,777
Project advances	2,630,564	2,457,340
Prepaid expenses	7,724	10,814
	$ 7,709,989	6,596,455
Liabilities and Net Assets		
Current liabilities:		
Accounts payable and accrued liabilities	$ 85,759	81,873
Project advances payable	34,205	153,784
Deferred contributions (note 4)	7,324,538	6,095,311
	7,444,502	6,330,968
Net assets	265,487	265,487
	$ 7,709,989	$ 6,596,455

Commitments (note 5)

See accompanying notes to consolidated financial statements.

On behalf of the Board:

Director

Director

GENOME PRAIRIE

Consolidated Statement of Operations and Changes in Net Assets

Year ended March 31, 2023, with comparative information for 2022

	2023	2022
Revenue:		
Project revenues (note 4)	$ 4,749,632	$ 4,136,639
Administrative support revenues (note 4)	869,317	1,125,990
Interest income	128,543	26,446
	5,747,492	5,289,074
Expenses:		
Project expenditures	4,749,632	4,280,113
General and administrative	940,633	933,328
Project development	57,227	15,633
	5,747,492	5,289,074
Excess of revenue over expenses	-	-
Net assets, beginning of year	265,487	265,487
Net assets, end of year	$ 265,487	$ 265,487

See accompanying notes to consolidated financial statements.

GENOME PRAIRIE

Consolidated Statement of Cash Flows

Year ended March 31, 2023, with comparative information for 2022

	2023	2022
Cash flows from (used in):		
Operations:		
Excess of revenues over expenses	$ -	$ -
Change in non-cash operating working capital:		
Accounts receivable	28,288	506,467
GST receivable	34,022	(33,348)
Project advances	(173,224)	(743,982)
Prepaid expenses	3,090	(1)
Accounts payable and accrued liabilities	3,886	(25,568)
Project advances payable	(119,579)	(361,788)
Deferred contributions	1,229,227	1,666,892
Increase in cash and cash equivalents	1,005,710	1,008,672
Cash and cash equivalents, beginning of year	4,012,427	3,003,755
Cash and cash equivalents, end of year	$ 5,018,137	$ 4,012,427
Cash and cash equivalents consist of:		
Cash	$ 3,351,684	2,393,851
Investment certificate	1,666,453	1,618,576
	$ 5,018,137	$ 4,012,427

See accompanying notes to consolidated financial statements.

GENOME PRAIRIE

Notes to Consolidated Financial Statements

Year ended March 31, 2023

1. Nature of business:

Genome Prairie (the "Corporation") was incorporated in 2000 under the *Canada Corporations Act* and transitioned in 2013 to the *Canada Not-for-profit Corporations Act* as a not-for-profit organization. The Corporation funds organizations and institutions that conduct genomic research and development for the economic benefit of the Prairie Region (Saskatchewan and Manitoba) and Canada. The majority of Genome Prairie's operational funding is received from Genome Canada.

2. Significant accounting policies:

(a) Basis of presentation:

The consolidated financial statements include the accounts of the Corporation and its subsidiary, Interra Biosciences Inc.

These financial statements have been prepared in accordance with Canadian accounting standards for not-for-profit organizations ("ASNPO").

(b) Use of estimates:

The preparation of financial statements in accordance with ASNPO requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amount of revenue and expenses during the year. Significant items subject to such estimates and assumptions include deferred revenue. Actual results could differ from these estimates.

(c) Revenue recognition:

The Corporation follows the deferral method of accounting for contributions. Restricted contributions are recognized as revenue in the year in which the related expenses are incurred. Unrestricted contributions are recognized as revenue when received or receivable if the amount to be received can be reasonably estimated and collection is reasonably assured.

During the year ended March 31, 2023 and March 31, 2022 the Corporation received contributions related to the purchase of equipment. There is uncertainty related to the future ownership of this equipment. Therefore, the Corporation has expensed this as project costs and recognized the corresponding contribution as project revenue.

(d) Cash and cash equivalents:

Cash and cash equivalents include cash on hand and short-term deposits which are highly liquid with original maturities of less than three months or are readily convertible to known amounts of cash and are subject to insignificant risk of changes in value.

2. Significant accounting policies (continued):

(e) Financial instruments:

Financial instruments are comprised of financial assets (including cash and cash equivalents, accounts receivable, GST receivable, project advances, and prepaid expenses) and financial liabilities (including accounts payable and accrued liabilities and project advances payable). Financial instruments are initially recognized at fair value and subsequent measurement is at amortized cost with investment income recorded on an effective interest basis.

(f) Income taxes:

The Corporation qualifies as a tax-exempt organization under Section 149 of the Income Tax Act.

(g) Government assistance:

Government assistance related to current revenue and expenses is included in the determination of excess of revenue over expenses for the period.

3. Financial risk management:

The fair value of the Corporation's cash and cash equivalents, accounts receivable, and accounts payable and accrued liabilities approximate their carrying amounts due to the short-term to maturity of these financial instruments. The Corporation has exposure to the following risks from its use of financial instruments:

Interest rate risk

The Corporation is exposed to interest rate risk arising from fluctuations in interest rates on amounts invested in interest bearing accounts and investment certificates. Cash, when received, is deposited into an interest-bearing account which earns interest at a rate of 0.40%. The current investment certificate is a term deposit which earns interest at a rate of 3.50% and matures on March 17, 2027. The term deposit may be redeemed by the Corporation at any date prior to the maturity date without penalty.

Credit risk

The Corporation's financial assets including accounts receivable are not exposed to significant credit risk since the majority of receivables are from government organizations.

Other risks

The Corporation has no significant exposure to liquidity risk, currency risk or other price risk. There is a concentration of risk due to the limited number of individual counterparties to the Corporation's cash and cash equivalents and investment certificate.

4. Deferred contributions:

The Corporation receives funding from Genome Canada, Provincial Ministries, Western Economic Diversification Canada and other sources to be held, administered and distributed in accordance with the related funding agreements between Genome Prairie and the other parties. Deferred contributions relate to expenses of future periods and represent the unspent externally restricted funding and related investment income, which are for the purposes of providing funding to eligible recipients and the payment of operating and capital expenditures in future periods. The changes in the deferred contribution balances for the period are as follows:

	2023	2022
Opening deferred contributions for expenses of future periods	$ 6,095,311	$ 4,428,419
Contributions during the year:		
Genome Canada	5,970,450	5,873,929
Province of Saskatchewan – Projects	413,506	528,293
Western Grain Research Foundation	-	28,015
Genome Alberta	265,203	14,000
Western Economic Diversification	-	171,009
Other	15,675	32,194
Manitoba Agriculture, Food and Rural Initiatives	183,343	225,000
University of Saskatchewan – Project development	-	4,818
Total contributions received	6,848,177	6,877,258
Total contributions available	12,943,488	11,305,677
Less amounts recognized as project revenues	(4,749,633)	(4,136,638)
Less amounts recognized as administrative support revenues	(869,317)	(1,125,990)
Plus: Deferred funds receivable	-	67,895
Project development funds used	-	(15,633)
Closing deferred contributions for expenses of future periods	$ 7,324,538	$ 6,095,311

Deferred contributions are comprised of the following balances:

	2023	2022
Projects	$ 6,644,295	$ 5,627,924
Operating expenses	680,243	467,387
Closing deferred contributions for expenses of future periods	$ 7,324,538	$ 6,095,311

5. Commitments:

Funding commitments:

The Corporation signed a funding agreement with Genome Canada on March 24, 2020 which applies to all funding awarded and provided to the Corporation from April 1, 2020 until such time that a new or amended agreement is signed or the agreement is cancelled. Amended agreement was finalized and signed on January 30, 2023 which provided funding award and to the Corporation from April 1, 2022 to March 31, 2027.

Base funding

The Corporation received a Notice of Award from Genome Canada on March 29, 2022, approving administrative support funding up to a maximum of $880,000 for fiscal years 2022-23 and 2023-24. As a condition of funding under this Notice of Award, the Corporation is expected to secure co-funding from other sources in an amount at least equal to the contribution of Genome Canada or provide Genome Canada with a documented plan to meet this requirement within a reasonable time period. As specified in the funding agreement, Genome Canada may provide funding to the Corporation notwithstanding the fact that formal commitments from other parties have not yet been secured. In such cases, funds provided in advance "in good faith" shall not be reimbursable in the event such commitments from other parties are not secured, but Genome Canada may then terminate the present agreement or suspend or reduce funding.

Project funding

Genome Canada has approved funding remaining of $5,018,804 (2022 - $7,549,854) to be provided to the Corporation for ongoing and future research projects. In accordance with the funding agreements, the Corporation will secure additional financial contributions or in-kind commitments at amounts specified in the Notice of Awards issued by Genome Canada. As at March 31, 2023, the Corporation had $15,934,318 (2021 – $11,675,986) in co-funding related to these projects still to be applied.

Lease commitments:

The Corporation has entered into a sub-lease agreement for its Saskatoon office space expiring on December 31, 2025. The approximate annual rental is $50,000. The Corporation has also entered into a sub-lease agreement with University of Manitoba for its new Winnipeg office space with approximate annual rental of $16,000 upon expiration of the agreement at the former locations on March 31, 2022.

GENOME PRAIRIE PARTNERS

MAJOR FUNDING AGENCIES

Genome Canada

MAJOR PROJECT FUNDERS

Agriculture and Agri-Food Canada

Public Health Agency of Canada / Agence de la santé publique du Canada

University of Saskatchewan

University of Manitoba

Shared health / Soins communs Manitoba

Manitoba Agriculture

Government of Saskatchewan Ministry of Agriculture

RDAR Results Driven Agriculture Research

Saskatchewan Pulse Growers

SaskWheat Development Commission

Manitoba Crop Alliance

WGRF Advancing Agriculture through Research

GIFS

Canada

CAPP Canadian Association of Petroleum Producers

Saskatchewan Health Authority