

# PARTNERSHIP

– IT'S IN OUR DNA



**GenomeCanada**

ANNUAL REPORT / 2016-17

Proud to celebrate



CANADA 150



# Table of Contents



**4** Healthy future forests

Birthdays  
beaver **6**



**8** Breaking down corrosion



Harvesting innovation **10**

**12** Better feed, better fish

- 1 Messages from the Chair, and the President and Chief Executive Officer
- 3 Partnering for Success
- 16 Highlights 2016-17
- 18 Pursuing our Objectives
- 25 Active Projects Funded
- 40 Genomics Enterprise
- 41 Governance
- 44 Financial Management
- 46 Auditor's Report
- 58 Acknowledgement



**14** Safe water



**Genome**Canada

Genome Canada is a not-for-profit organization that acts as a catalyst for developing and applying genomics and genomics-based technologies and, in so doing, creates economic and social benefits for Canadians.

**Published by Genome Canada**

Excerpts from this document may be reproduced for individual use without permission, provided the source is fully acknowledged. Reproduction in whole or in part for purposes of resale or redistribution, however, requires written permission from Genome Canada.

© Genome Canada 2017

*Cette publication est aussi disponible en français.*



## Messages from the Chair, and the President and Chief Executive Officer

As Canada celebrates its 150th anniversary, it is worth reflecting on the crucial role that science and innovation have played in our nation's development. Canada is renowned for its rich natural resources, and homegrown scientific breakthroughs have driven key developments within our agriculture, forestry, fisheries, aquaculture, energy and mining sectors, which have been a boon to Canada's economy. In health care, these same scientific breakthroughs have saved lives and improved quality of life for Canadians and people worldwide.

While many areas of science and technology have shaped Canada and the world for decades, genomics is a relatively young science. Still, impacts of Canadian research in the field are starting to be felt at home and abroad.

**“Canada is a scientific hub and global leader in genomics.”**

— Moura Quayle, chair

We are beginning to reap the benefits of investments that the Government of Canada, provincial governments and other partners have made since 2000 in creating a thriving Canadian genomics enterprise. Genome Canada has led the way in building up large-scale genomics research capacity, infrastructure and a foundation of fundamental research work. This has put Genome Canada in a position to seize on opportunities – opened up by advances in technology – to shift into the realm of genomics applications and innovations benefiting society.

Genome Canada's programs are evolving to translate genomics research into applications across sectors of importance to Canada's economy and society. Industries as diverse as pork production, offshore oil and gas exploration, site decontamination and drug development are not only becoming aware of the power and potential of genomics to advance their fields, but are co-investing in applied genomics research projects to derive maximum benefit from the solutions genomics can offer.

Such research partnerships are not created overnight. It is a process, one that sometimes takes years, for those in the private, public and not-for-profit sectors to realize what genomics is and what it can do for them. As an example, key players in the mining industry are now full-fledged partners in multiple projects, using genomics as a tool to better monitor, manage and treat mining wastewater, among other things.

Looking ahead, Genome Canada plans to increase outreach to industry, government departments and others who are dealing with

productivity, environmental and social problems where genomics could play a role in delivering solutions. We will link potential users of the science with the genomics on offer at our many world-leading academic institutions and technology platforms across Canada.

And the job extends well beyond Canada. We will engage at a deeper level with the international community to attract more international partnerships with organizations and government agencies worldwide. We have a great opportunity to brand Canada as a scientific hub and global leader in finding exciting solutions from genomics.

We also want to show young Canadians the importance of genomics as a field of scientific inquiry for them. It is critical that the next generation learn how to master genomics and related tools as a means to deal with some of the greatest biological challenges of our time, such as climate change, chronic and infectious diseases, and food security, to name just a few.

It has been an honour to serve in my first year as chair of Genome Canada. I thank the Government of Canada for its continued support, my fellow board members, the leadership team and staff at Genome Canada, and the regional Genome Centres for their dedication and excellent work. Our research community is building a growing network of partners who provide amazing contributions. This collaboration will ensure we help Canada continue to be a nation of innovators for the next 150 years and beyond.



Moura Quayle  
Chair

~

**W**e are delighted to present an overview of our work during fiscal year 2016-17. Our research community has delivered some outstanding outcomes and we have made multiple new investments in large-scale science, leading-edge technologies and translation across multiple sectors, all with a view to deliver benefits to Canadians.

Partnerships are at the heart of Canada's genomics enterprise. They are the basis of Genome Canada's business model, and a key enabler of our success. Quite simply, partnerships are in our DNA!

Our partnerships work on many levels. As the lead funder of genomics in Canada, our investments catalyze co-funding from many sources – private industry, not-for-profit organizations and the public sector. Provincial governments deserve special recognition as their support, delivered through Canada's six regional Genome Centres (Genome British Columbia, Genome Alberta, Genome Prairie, Ontario Genomics, Génome Québec and Genome Atlantic), ensures that the dollars invested by all address regional priorities and challenges right across the country.

Our close collaboration with the Centres means that Genome Canada is more than a federal program. It is truly a *national* program. Everyone is in. The Centres play an instrumental role in deepening our engagement with many new co-funding partners who are local, regional, national and international in scope. These relationships serve to strengthen Canada's genomics enterprise as a whole through robust investment in research.

Beyond funding, we catalyze science partnerships across regions and sectors. This is quite unique and advantageous to Canada. We are the only G7 country with an integrated genomics program, wherein our investments are multi-sectoral and, furthermore, research teams are multidisciplinary. This structure allows cross-fertilization to take place. Capacity built in British Columbia for health genomics has served as a platform for forestry genomics. Forestry genomics experts in Western Canada are collaborating with experts in Quebec who are tackling similar challenges.

Canada is a huge country geographically, yet a small one in terms of population. Our research community benefits from being part of national and international collaborations where they can both learn and contribute.

Further, what we support under the genomics umbrella is broad – it is not just genome sequencing. We support a full suite of “-omics” technologies (for example, proteomics, metabolomics and epigenomics) as well as disciplines such as bioinformatics and computational biology, which seek to derive full value from the “big data” generated from genomics research. Our teams also feature experts from the social sciences and humanities who examine the societal dimensions of this disruptive technology to ensure risk is reduced and benefits maximized for Canadians. In this field, no one individual can do it alone. Multidisciplinary teams are critical for success.

**“Genome Canada is more than a federal program. It is truly a national program. Everyone is in.”**

— Marc LePage, *president and chief executive officer*

Last but not least, we foster a partnership of sorts through the makeup of our programs portfolio – that of science and innovation. The key to a successful enterprise is to work on both fuelling the pipeline for innovation through investment in fundamental research and technology platforms, while at the same time priming the receptor capacity for applications, including commercialization opportunities for Canadian business.

In short, partnerships are the glue that hold together the strong collaborative network that is Canada’s genomics enterprise. And the quality and quantity of partnerships is what will underpin our ongoing success.

Marc LePage  
President and chief executive officer



## PARTNERING FOR SUCCESS

Innovation is at the heart of  
all we do at Genome Canada.





# healthy future forests

**University of British Columbia researchers and British Columbia's government are joining forces to protect and enhance one of the province's most iconic symbols and valuable resources.**

Dr. John H. Russell of British Columbia's Ministry of Forests, Lands and Natural Resource Operations



---

---

The \$2.2-million western redcedar durability project is funded through Genome Canada’s Genomic Applications Partnership Program (GAPP) in collaboration with Genome British Columbia and others. GAPP partners academic researchers with the private and public sectors to promote genomics-derived solutions that address real-world challenges or opportunities. The projects are expected to have considerable economic and social impacts in the near term, spurring innovation, commercialization and growth in Canada.

---

---

**T**he life of the majestic western redcedar and the history of British Columbia have been intertwined for as long as humans have walked, fished and forested the West Coast. Known as *arborvitae* – the tree of life – the redcedar is both British Columbia’s official tree and a \$1-billion annual industry. (Scientists spell “redcedar” as one word to indicate a false classification; the redcedar is actually a member of the cypress family.)

Industry will face a challenge as they transition from old growth forests, with trees more than 250 years old, to younger second-growth forests that have sprung up following human-caused events like logging or natural disturbances such as wildfire. Because of their size and age, second growth forests are less productive than old growth forests, generating less wood with lower durability.

In addition, the health of redcedar forests can be negatively impacted by shifts in the quantity and types of pests influenced by climate change.

Modelling has shown that with warmer temperatures, current pest populations will increase in certain habitats, causing significant mortality and loss of growth and usable wood.

Traditional breeding strate-

gies for western redcedar can take decades to produce the desired traits of wood durability inherent in old growth trees. Dr. Joerg Bohlmann of the University of British Columbia is working with Dr. John H. Russell of British Columbia’s Ministry of Forests, Lands and Natural Resource Operations to apply genomic selection to reduce that time by up to 30 years. Genomic selection will accelerate the development of tree populations that are resistant to multiple pests and reduce the need for time-consuming and costly phenotyping (this involves observing the characteristics of an organism resulting from the interaction of its genes with the environment). Because key industry producers and users of these trees are actively participating in the project, technology transfer and commercialization will be seamless.

The Genome Canada-funded project, entitled Cedar Enhanced Durability and Resistance (CEDaR): Sustainability of Canada’s western redcedar forestry sector, will produce a new generation of western redcedar that has the high-value attributes of old growth trees, is more resistant to pathogens and wildlife that feed on a tree’s leaves, shoots and fruit, and is better adapted to future climates.



“This research will produce multiple savings to industry, including decreased forest management costs, increased profit from the harvesting of sound wood from healthy forests 30 years earlier than with traditional methods and increased profits from seed sales to other companies.”

— Dr. John H. Russell, research scientist, forest genetics, tree improvement branch, British Columbia Ministry of Forests, Lands and Natural Resource Operations



PHOTO: TORONTO ZOO

# birthday beaver

**For Canada's 150<sup>th</sup> birthday, a team of researchers wanted to give something back by celebrating the country's national symbol and mapping the genome of the Canadian beaver.**

---

---

The sequencing of the beaver was carried out by The Centre for Applied Genomics at SickKids in Toronto, in partnership with the Ontario Institute for Cancer Research, the Royal Ontario Museum, the University of Toronto and the Toronto Zoo. The Centre for Applied Genomics is one of 10 genomics technology platforms across Canada that Genome Canada supports. (Since 2000, Genome Canada has invested more than \$30 million in The Centre for Applied Genomics, which has leveraged more than \$9.8 million in co-funding for the platform.)

---

---

**L**ike so many great eureka moments in science, it checked a number of crucial boxes. Nobody had mapped the genome of the Canadian beaver; the sequencing method used would provide greater insight into the genetic clues to some diseases and disorders; it had exceptional and timely appeal for a broad audience; and it would be the perfect way for Canadian genome scientists to mark Canada's 150<sup>th</sup> birthday.

When Dr. Stephen Scherer, director of The Centre for Applied Genomics at The Hospital for Sick Children (SickKids) in Toronto, and his colleague Dr. Si Lok decided to map the genome of Canada's national animal, it was partly a patriotic bid to ensure that a genetics team from another country didn't beat them to it in the global enthusiasm to map the genomes of every living organism from aphids to zebras.

While they could have chosen any mammal on which to test their new *de novo* sequencing method, the

researchers chose Ward, a 10-year-old beaver at the Toronto Zoo and mate of June (as in the Cleavers, of *Leave It To Beaver* fame), because of his symbolic value. This sequencing method allows the scientists to assemble a gene map from scratch rather than aligning a partial map with a reference genome. The results, published in the online edition of *G3: Genes | Genomes | Genetics* in January 2017, hold tremendous promise for research into the genetic markers of certain diseases and disorders, because *de novo* mapping enables scientists to find new types of genetic variations that aren't revealed by current technologies.

Dr. Scherer, who is also a professor in the Department of Molecular Genetics and director of the McLaughlin Centre at the University of Toronto, is one of the world's most respected scientists. In 2014, Thomson Reuters Intellectual Property & Science selected him as a citation laureate in physiology or medicine

– a "Nobel class"-worthy distinction. Genome Canada has funded his Autism Genome Project, an unprecedented initiative bringing together leading geneticists, clinicians and genome scientists undertaking autism research in Canada, and linking to 170 scientists from 10 other countries worldwide.

While sequencing the genome of the Canadian beaver may sound like the nerdiest science experiment ever, the very serious project could change the lives of millions of families affected by autism and other disorders and diseases now and in future generations. And it served the public education purpose of engaging citizens in the process.

"I heard from more than 200 Canadians, including Canadians in the U.S.A., how proud they were that the *Castor canadensis* genome was done in Canada," said Dr. Scherer. "It's our national icon, our heritage, so we should be the ones to decode what is our own."

"The *de novo* sequencing method, first used to sequence the beaver genome, when applied to humans will give us better clues to the genetic links to autism spectrum disorder and potentially other disorders and diseases."

— Dr. Stephen Scherer, director, The Centre for Applied Genomics





# breaking down corrosion

**Genome scientists at four Canadian universities are collaborating with international colleagues and industry to harness genomics in breaking down the microbial corrosion that can damage pipelines.**

A pipeline flow loop housed at InnoTech Alberta, similar to that which will be used to simulate microbial corrosion testing under simulated field environmental conditions

---

---

The \$7.9-million Managing Microbial Corrosion in Canadian Offshore and Onshore Oil Production project is a collaboration between Genome Alberta, Genome Atlantic and other partners. Launched in January 2017, it is one of 13 projects funded as part of Genome Canada's 2015 Large-Scale Applied Research Project Competition – Natural Resources and the Environment: Sector Challenges – Genomic Solutions. This \$110-million program was designed to harness genomics to address challenges in Canada's natural resources and environment sectors.

---

---

**A**s long as oil and gas have been transported by pipelines, ruptures have produced both environmental and economic costs. And the main cause of pipeline incidents is metal loss – or corrosion – which causes roughly 35 per cent of pipeline leaks and costs \$2.5 trillion around the world annually.

While that corrosion is caused by a range of internal and external factors, microbiologically influenced corrosion (MIC) is to blame for 20 per cent of it. Genomics is helping industry to combat microbial corrosion through better understanding, mitigation and management of the MIC process.

Leading the Genome Canada-funded project are Dr. Lisa Gieg, an associate professor in the Department of Biological Sciences at the University of Calgary; John Wolodko, an associate professor and Alberta Innovates Strategic Chair in Bio and Industrial Materials at the University

of Alberta; and Faisal Khan, a professor and the Vale Research Chair of Process Safety and Risk Engineering at Memorial University.

The leaders and their interdisciplinary team will be able to break down degradation trends associated with certain microbes and particular chemistries that produce corrosion. This will allow industry end-users of the technology to better predict where microbial corrosion will strike. While pipeline corrosion will be a major focus, the research will also look at all points of contact between oil and steel in extraction, production and processing to help make the industry safer.

The project is also investigating questions at the intersection of genomics and society to avoid unintended consequences, cultivate success and contribute to Canada's leadership in the 21<sup>st</sup> century's global bioeconomy. In particular, the project is studying the prevalence of MIC in Canada and abroad, the



University of Calgary's Dr. Lisa Gieg

“Ongoing collaboration between researchers and industry within the project will help facilitate the translation of our research outcomes to actual microbiologically influenced corrosion management practices in oil and gas operations.”

— Dr. Lisa Gieg, associate professor, Department of Biological Sciences at the University of Calgary

multidisciplinary nature of MIC research, and the translation and adoption of new knowledge and technologies in the oil and gas sector.

Key outcomes of the project will be translated into recommended guidelines and best practices documents for use by the Canadian and global oil and gas industry. “Ultimately, this project will identify the key performance indicators required to model and monitor for microbiologically influenced corrosion, along with optimizing treatment strategies to prevent or remediate the problem,” said Ken Wunch, Energy technology platform leader at Dow Microbial Control.



# harvesting innovation

**Researchers from the University of Saskatchewan have partnered with Indigo Agriculture Inc. to use genomic science in the international effort to produce crops that will thrive in 21<sup>st</sup>-century conditions to meet the world's growing nutritional and industrial demands.**

The Food and Agriculture Organization of the United Nations predicts that world food production will have to increase by 70 per cent before 2050 to feed a growing global population. That goal is complicated by the need for crops to adapt to the extreme conditions of climate change and by the increasing loss of freshwater sources.

Achieving global food security despite these conditions is considered such a compelling challenge that it is the second of 17 United Nations Sustainable Development Goals, after the eradication of poverty. Scientists have risen to that challenge by deploying the research tools unleashed by genomics. This effort is comparable to the Green Revolution of the 1960s that used advances in agronomy to drastically increase crop yields in India and other developing countries.

In describing the need for a second Green Revolution, philanthropist Bill Gates said, “The charge is clear—we have to develop crops that can grow in a drought; that can survive in a flood; that can resist pests and disease...we need higher yields on the same land in harsher weather.”

The Genome Canada-funded Augmenting the Plant Microbiome to Improve Crop Yield and Stress Resilience project builds on a breakthrough in genomic crop science by University of Saskatchewan microbiologists Vladimir Vujanovic and Jim Germida. Drs. Vujanovic and Germida discovered a group of symbiotic microbes in plant tissues that may enable substantially improved seed



University of Saskatchewan's Dr. Vladimir Vujanovic (RIGHT) and colleague.

The Augmenting the Plant Microbiome to Improve Crop Yield and Stress Resilience project aims to dramatically improve yield and stress resistance in food crops. This \$24.4-million project, a collaboration with Genome Prairie and others, received \$16 million through the Genomic Applications Partnership Program.

germination, yield, and drought- and heat-stress resilience in more than 20 varieties of wheat, barley, pulses and canola. These crops account for more than \$15 billion in annual production in Canada alone.

Indigo's translation and commercialization of this research will help farmers by expediting the development of crops that are healthier and produce higher yields. Already, the University of Saskatchewan partnership with Indigo has produced a potential microbial treatment for

major crops that is being evaluated as a candidate for commercial launch.

“The synergy created by the partnership has impacted Indigo's innovation platform and helped the company to further optimize the potential of the microbial treatments,” said Ray Riley, senior vice-president, product development at Indigo. “In the course of the partnership, Indigo (formerly known as Symbiota) has more than doubled its employee count and launched its first products.”

“ This highly successful partnership represented a successful public-private collaboration on finding solutions impacting time-to-market of innovative agricultural products. We are hopeful that this relationship has opened doors for additional opportunities for similar partnerships that bring value to the growers and the environment.”

— Ray Riley, senior vice-president, product development, Indigo Agriculture



better feed,  
better fish

**Scientists at Memorial University, the University of Prince Edward Island and aquaculture firm Cargill Aqua Nutrition are using genomics to help the aquafeed industry develop feeds that improve the health of farmed salmon and protect them against sea lice and pathogenic viruses and bacteria.**



In the past 20 years, aquaculture production in Canada has more than doubled to close to \$3.1 billion in economic activity a year. The industry now employs about 15,000 Canadians and exports 101,000 tonnes of food products.

However, the health of farmed salmon in Canada is perpetually threatened by infectious diseases, including those caused by sea lice, pathogenic viruses and bacteria.

The quality of feed can affect salmon health. Better feed can enhance fish health, reduce the need for antibiotics and improve the rate at which fish grow. But until now, there has been no practical way for aquafeed companies to measure how well novel feeds work beyond weighing the fish and judging feed effectiveness using growth rates.

In the Genome Canada-funded Biomarker Platform for Commercial Aquaculture Feed Development project, launched in 2014, Dr. Matthew Rise of Memorial University, Dr. Richard Taylor of Cargill Aqua Nutrition (a division of Cargill, which purchased salmon nutrition company EWOS in 2015) and other collaborators are identifying and validating salmon genes related to growth, for inclusion in a biomarker panel. From individual fish, the researchers analyze the expression of approximately 30 genes associated with disease response and growth to determine the effects of various feeds and ingredients at the genomic level. One example of this is the impact of diet on lipid metabolism or antiviral immune response.

---

---

Both Genomic Applications Partnership Program projects – the \$3.8-million Biomarker Platform for Commercial Aquaculture Feed Development project and the \$4.5-million Integrated Pathogen Management of Coinfection in Atlantic Salmon project – involve partnerships with Genome Atlantic and others.

---

---

The process of translating that information into better-quality feed is about more than just boosting immunity. The genetic biomarkers enable researchers to track what each pathogen or other immune stimulus does to salmon and what a potential treatment does when added to salmon feed. For bacterial infection, for example, it is important to control chronic inflammation. For viral infection, controlling digestible energy and adding immune stimulants may be necessary.

The genomic tools developed through this project allow Cargill Aqua Nutrition, one of the world's largest producers of aquafeeds, to determine right down to the cellular level how fish are impacted by the feed. Furthermore, the company is able to quickly and accurately assess the impact of new feed ingredients on fish rather than waiting months for a fish to show a noticeable change in size.

This technology is helping Cargill Aqua Nutrition to improve their feed formulas and develop new, high-quality feeds. The company is commercializing new feeds within

the life of the project, with more new products likely to follow in the coming years. Cargill Aqua Nutrition sources approximately 80 per cent of feed ingredients from Canada, and sells feed to Canada, the U.S.A., Mexico and Asia.

Dr. Rise, Dr. Taylor, Dr. Mark Fast of the University of Prince Edward Island and their collaborators subsequently received funding for a second GAPP project in 2016 – Integrated Pathogen Management of Co-infection in Atlantic Salmon. This project uses the tools and knowledge developed in the Biomarker Platform project to better understand salmon response to a very complicated situation that can occur at salmon farms: the exposure of fish to more than one pathogen at a time (co-infection).

This academic-industry partnership will result in the increased sustainability of the Canadian salmon industry, the improvement of animal welfare in the aquaculture industry and the application of these same biomarkers to studies of wild salmon stocks.

“These collaborative projects, with funding from Genome Canada, have enabled us to bring an entirely new realm of information to bear on scientific problems that, otherwise, would have taken many more years to solve. This has allowed us to better serve our shareholders, our clients, and Canadian and international consumers.”

— Dr. Richard Taylor, senior research scientist, Cargill Aqua Nutrition



# safe water

## **Canadians take safe drinking water for granted. But a combination of chemicals and climate change have made blue-green algae blooms a threat to that safety, and investment in preventing toxic outbreaks a necessity.**

**I**n the same way that DNA testing has revolutionized criminology, genomics has transformed environmental research, enabling us to solve mysteries that could otherwise pose significant public health risks.

One of those problems is the growing contamination risk posed to Canada's drinking water by blue-green algae blooms. The algae, known as cyanobacteria, have undergone a reproductive boom fuelled by global warming and increased phosphorous use. This explosion has

choked food chains and disrupted fisheries from the Great Lakes to the Yellow Sea.

The proliferation of algae has fuelled activism by business and environmental groups, added to the litany of indirect effects of climate change and generated an annual springtime gallery of close-up and satellite photos of blue-green shoreline blobs from around the world. Algae blooms are estimated to cost \$825 million annually in damages in the United States alone.

As with most environmental disruptions, algae blooms pose a risk not only to animal life – by causing hypoxia as a result of consuming disproportionate amounts of oxygen and creating vast “dead zones” – but to human health as well, by releasing cyanotoxins into the water supply that can cause illness and even death.

The Genome Canada-funded project Algal Blooms, Treatment, Risk Assessment, Prediction and Prevention through Genomics (ATRAPP) will leverage the science

---

---

The \$12.3-million Algal Blooms, Treatment, Risk Assessment, Prediction and Prevention through Genomics (ATRAPP) project is one of 13 large-scale applied research projects delivering genomics solutions to challenges in Canada's environment and natural resource sectors. ATRAPP partners include Génome Québec, among others.

---

---



“Our partnership in the Algal Blooms, Treatment, Risk Assessment, Prediction and Prevention through Genomics project has enhanced our ability to identify the cyanobacteria that contaminate our water treatment facilities and determine the best methods for preventing and eliminating them. It is also helping us keep the Richelieu River clean.”

— Eric Desbiens, chief of potable water division, City of Saint-Jean-sur-Richelieu, Quebec

of genomics to predict, detect and prevent cyanotoxin outbreaks.

Led by Drs. Sébastien Sauvé and Jesse Shapiro of the Université de Montréal, along with Sarah Dorner of Polytechnique Montréal, the ATRAPP team will develop a chemical-genomic diagnostic toolkit. This toolkit will assess the risk of toxicity in water sources, and guide municipalities and water quality authorities in prevention and treatment strategies.

“Including genomic data will allow us to have an unprecedented database to build a much stronger model,” says Dr. Sauvé. “The

genomic work will allow us to better understand the links with a broad range of toxins and hopefully identify which genomic biomarkers are best suited to help detection and prediction of blooms.”

Detection and prediction are particularly crucial because it is currently possible for drinking water to become contaminated by toxic algal blooms without that contamination being detected. The ATRAPP project aims to propose procedures to detect algal outbreaks so that drinking water treatment can be adjusted to prevent exposure.



**Boats moored in a harbour overtaken by algae. Opposite page: Algae in water.**



# HIGHLIGHTS 2016-17

## **JUNE 13, 2016**

The international wheat sequencing consortium, of which Canada is a leading player, releases a key resource to the scientific community: the whole genome assembly for bread wheat. Wheat breeders and scientists around the world will be able to download and use this invaluable new resource to accelerate crop improvement programs and wheat genomics research.

## **JULY 11, 2016**

Five new GAPP projects are announced. They apply genomics toward improvements in cancer treatment, plant breeding, bioremediation, and oil and gas exploration.

## **JULY 20, 2016**

A funding opportunity is launched to support genomics technology platforms and provide technology development funds to facilities across Canada.

## **SEPTEMBER 13, 2016**

Investment in 16 new genomics “big data” research projects are announced. The bioinformatics and computational biology projects will yield new tools to address issues ranging from infectious disease outbreaks to managing food crops to support the world’s growing population.

## **OCTOBER 4-5, 2016**

Genome Canada hosts a Forum on Genomics and Precision Health in Toronto. The aim of this meeting is to develop a strategy to further the implementation of genomics in clinics. International perspectives, the Canadian context and patient perspectives are all represented.

## **OCTOBER 11, 2016**

Six new GAPP projects are announced, involving the application of genomics to solve problems facing Canada’s forestry, health, agri-food and aquaculture sectors.

## **DECEMBER 1, 2016**

A workshop report from the February 2016 Forum on Genomics and Antimicrobial Resistance is released by Genome Canada and partners. The report elaborates on

an approach to tackle this mounting public health issue across multiple sectors such as agriculture, human health and environment.

## **DECEMBER 8, 2016**

A \$110-million investment in 13 large-scale applied research projects is announced. These projects will deploy genomics to address challenges in Canada’s natural resources and environmental sectors. The projects look to mitigate the effects of climate change on forestry and fisheries, protect the Arctic, and support polar bears and other wildlife.

## **DECEMBER 9, 2016**

Funding of \$18.3 million is announced for 25 projects that will advance disruptive innovation in genomics to improve human health, agriculture and natural resources. The transformative genomics-based technologies and ideas being supported will help tackle some of Canada’s toughest challenges, create new market opportunities and spur job growth.

## **JANUARY 13, 2017**

A homegrown research team sequences the genome of an iconic Canadian animal – the beaver – just in time to kick off the country’s 150th anniversary.

## **JANUARY 30, 2017**

A new funding opportunity launches – Genome Canada’s 2017 Large-Scale Applied Research Project Competition: Genomics and Precision Health. By the end of the fiscal year, 169 research teams express interest in applying.



The Honourable Kirsty Duncan, Minister of Science, hugs rare disease patient Sienna Knapp.

# GENOMICS ON THE HILL

**FEBRUARY 6, 2017**

Genomics on the Hill 2017 takes place on Parliament Hill, spotlighting the role of genomics in diagnosing and treating rare diseases, and in addressing climate change and advancing clean technology.



University of Ottawa rare disease researcher Dr. Izabella Pena (LEFT) explains her research to guests. Kate Young, Parliamentary Secretary for Science (MIDDLE TOP) and Geoff Regan, Speaker of the House of Commons (MIDDLE BOTTOM) address participants. Senator Kelvin Ogilvie (RIGHT) hosted the event.



Guests enjoy mingling with Canada's genomics community and learning about the role of this cutting-edge area of science in advancing precision health and addressing climate change challenges.

PHOTOS: JEAN-MARC CARISSE



# PURSUING OUR **OBJECTIVES**



# OUR MISSION

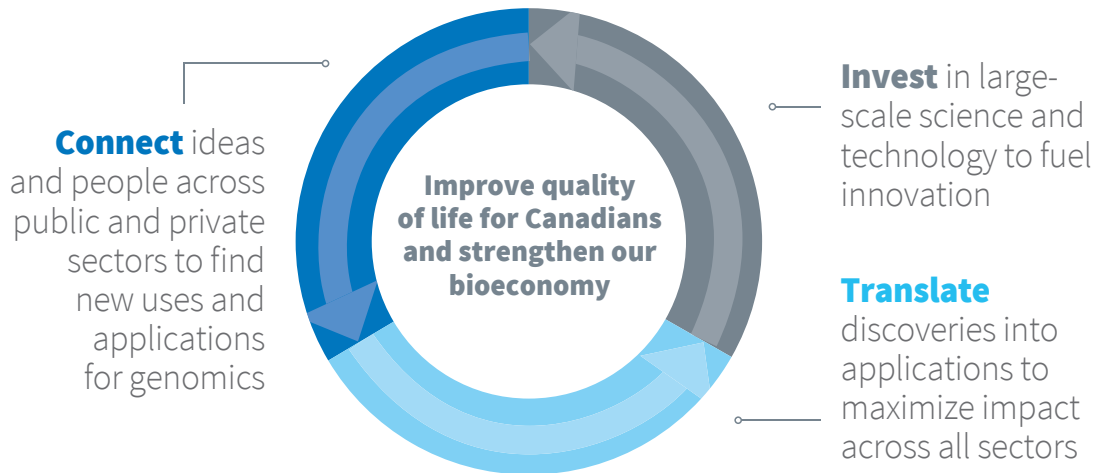


Figure 1

## Objectives

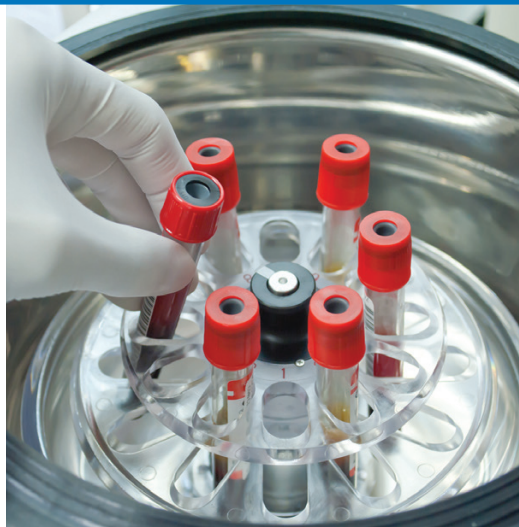
- Respond to societal needs by generating genomics discoveries and accelerating their translation into applications.
- Attract greater investment in genomics research from a broad range of stakeholders, in particular the private sector.
- Enhance the impact of genomics by transforming knowledge of the ethical, environmental, economic, legal and social challenges and opportunities (GE<sup>3</sup>LS) into sound policies and practices.
- Enhance the recognition of the value of genomics by increasing stakeholder appreciation of genome science, its applications and implications.

Genome Canada seeks to harness the transformative power of genomics to deliver benefits to Canadians. We do so through the pursuit of our mission and objectives. We continue to adapt our suite of programs to support the evolving Canadian bioeconomy and capitalize on opportunities across a wide range of industry sectors. We continue to secure strong levels of co-funding for our programs and projects from multiple partners in the public, private and not-for-profit sectors. Together, our work is driving innovation across many sectors of importance to the Canadian economy, resulting in job creation, growth, better health and prosperity for Canadians.



# CONNECT

Partnerships are foundational to all our corporate programs and activities. We establish them upfront both as part of program design and development, as well as a requirement in all the projects we support.



National and international partnerships are powerful mechanisms that allow us to have global impact. Here are some highlights from the 2016-17 fiscal year.

- **The 2015 E-Rare-3 Joint Transnational Call: Translational Research Projects on Rare Diseases** – This unique program enables collaboration on a translational level that contributes to achieving ambitious international goals to deliver new therapies and diagnostic tests for rare diseases in the coming years. Genome Canada is pleased to be working with five Canadian partners and various organizations from countries in the European Union in support of the program. The three genomics-related projects within the initiative focus on harmonizing phenomics information, improving the diagnosis and treatment of a cardiac arrhythmia syndrome, and studying a life-threatening autosomal skin disease to understand its pathophysiology, facilitating the development of targeted therapies.
- **Structural Genomics Consortium** – This public-private partnership supports the discovery of new medicines through open access research. Genome Canada continues its support for the Structural Genomics Consortium, which is demonstrating that open science leads to socio-economic impacts. In fact, the Structural Genomics Consortium has partnered with the Montreal Neurological Institute and Hospital as they work to expand the impact of brain research and become the first Open Science Institute in the world.





## INVEST

Funding was announced and flowed to a number of large-scale science and leading-edge technology projects during the 2016-17 fiscal year to fuel innovation in Canada.

- **2015 Large-Scale Applied Research Project Competition – Natural Resources and the Environment: Sector Challenges – Genomic Solutions** – Genome Canada and co-funding partners are investing \$110 million over four years in 13 large-scale applied research projects focused on using genomics to address challenges and opportunities of importance to Canada's natural resources and environmental sectors, including interactions between natural resources and the environment. The projects will empower Canada to address the climate change challenge, strengthen the bioeconomy and increase Canadians' wellbeing.
- **2015 Bioinformatics and Computational Biology Competition** – Genome Canada, in partnership with the Canadian Institutes of Health Research, is supporting 16 projects with a \$4-million investment. The projects will produce next-generation tools and methodologies to deal with the influx of large amounts of data produced by modern genomics technologies, and will provide the research community with broad access to these tools.
- **2015 Disruptive Innovation in Genomics Competition** – Genome Canada is investing in transformative genomics-based technologies and ideas to tackle some of Canada's toughest challenges, create new market opportunities and spur job growth. Genome Canada is investing \$5 million in 20 projects at the idea phase (Phase 1). An additional \$13.3 million is being invested by Genome Canada and co-funding partners in five projects at the prototype phase (Phase 2).

- **Emerging issues** – Genome Canada contributed toward a \$713,100 research project to study the pathology of the Zika virus – a public health emergency of international concern. The data generated through this project, based at the University of Saskatchewan, will provide tools to assess new ways to treat and prevent the spread of the virus.

In addition to these new investments, Genome Canada continued its support of several other ongoing large-scale science projects, and other international and national initiatives.

Some projects started wrapping up during the fiscal year. These included some funded through the **2012 Bioinformatics and Computational Biology Competition**.

We also provided operational support to 10 **technology platforms** across the country. The platforms not only offer the services needed to undertake research, but also provide advice on appropriate technologies, study design, data analysis and bioinformatics. Their services are available to the entire research community across Canada.



# TRANSLATE

Genome Canada is dedicated to translating knowledge into applications.

Here are some key mechanisms that helped achieve this throughout the 2016-17 fiscal year.

- **GAPP** – Two new rounds of projects, Rounds 5 and 6, received support. Round 5 saw five projects receive \$5.3 million in Genome Canada support with an additional \$11.6 million from partners, while Round 6 saw six new projects supported with \$5.9 million from Genome Canada and an additional \$13 million from partners, including provincial governments, and private and public sector organizations. Since the inception of the GAPP program in 2012, a total of \$120.9 million has been committed to 31 receptor-led projects. Through GAPP, we are connecting academic researchers with receptors in industry and the public sector, and incentivizing the development of genomics solutions and their application to real-world opportunities. The most recently funded projects range from helping protect farmed Atlantic salmon from infections – leading to potentially \$57 million in savings annually – to preventing adverse drug reactions, which account for \$14 billion to \$18 billion in health-care costs each year in Canada.
- **Mitacs partnership** – Genome Canada partners with Mitacs, a national non-profit research organization, to provide placements and funding for graduate students and post-doctoral fellows to work on GAPP projects within the operations of industry partners. The partnership helps

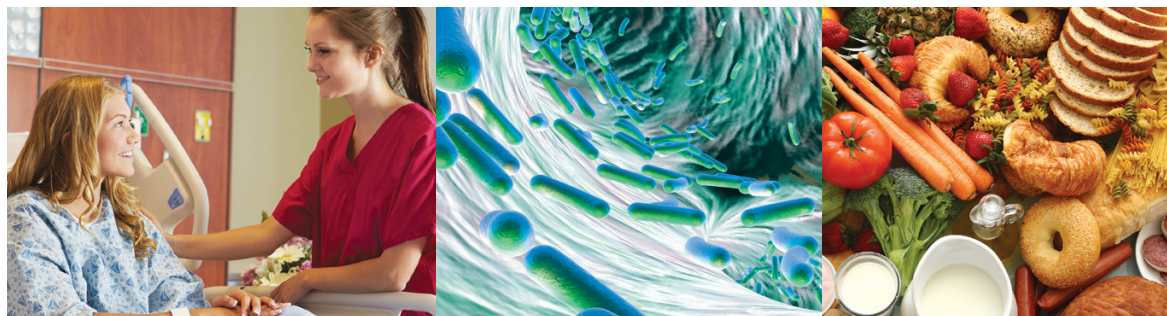
prepare Canada's next generation of innovators to advance the field of genomics by allowing candidates to apply their knowledge and skills in a real-world setting, while helping companies enhance their in-house research expertise.

- **GE<sup>3</sup>LS Network** – Genome Canada is supporting a GE<sup>3</sup>LS Network, which seeks to cross-fertilize and leverage the efforts of genomics research across the 17 projects being funded through the 2012 Large-Scale Applied Research Project Competition – Genomics and Personalized Health. Through an investment of up to \$2 million, the network is facilitating the sharing of best practices, priming and improving future research collaboration, accelerating progress toward the application of technologies, and maximizing the impact of investments in large-scale science personalized health projects.

# INCREASING **AWARENESS**

Genome Canada undertook a number of activities to increase awareness of genomics, including its power and impact, among key target audience groups. Here are some important activities that took place.

- **2016 BIO International Convention** – Genome Canada sponsored and exhibited at the BIO International Convention in San Francisco in June 2016. This provided visibility for the Canadian genomics enterprise, and enabled valuable partnerships to be formed and interaction to take place with international stakeholders and decision-makers.
- **Forum on Genomics and Precision Health** – Genome Canada led this forum, held in Toronto in October 2016, as well as other meetings with provincial and territorial health authorities, researchers and key opinion leaders to discuss strategies to advance the implementation of genomics in the health-care system, and feed into the development of a genomics and precision health strategy.
- **Forum on Genomics and Antimicrobial Resistance** – This forum, organized by Genome Canada and held in Ottawa in February 2016, brought together key stakeholders to discuss the current level of research and areas for potential collaboration in genomics and antimicrobial resistance.
- **Smart Technologies for Sustainable Global Food Security Forum** – Genome Canada helped convene this forum, which took place in Dublin, Ireland, on September 1 and 2, 2016, to inform future activities in the agriculture and agri-food sector.
- **Forum on societal implications of gene editing** – Genome Canada hosted this public forum in Ottawa on September 28, 2016, in partnership with the University of Ottawa Institute for Science, Society and Policy.
- **International symposium on gene editing** – Genome Canada co-sponsored this Organisation for Economic Co-operation and Development symposium, held in Ottawa September 29 and 30, 2016, to advance the understanding of the potential impacts and challenges of gene editing.



# LOOKING AHEAD

Under the funding agreement of \$237.2 million from Budget 2016, the operations of Genome Canada and the six regional Genome Centres will be funded into 2020.

Moving into 2017-18, Genome Canada will implement a number of new and ongoing initiatives. A new **large-scale applied research project competition to advance genomics and precision health** is underway. This is a key component of a precision health strategy that Genome Canada is developing. Genome Canada, Canada's six regional Genome Centres, Agriculture and Agri-Food Canada, the Natural Sciences and Engineering Research Council and the Canadian Food Inspection Agency will also work to develop a strategy to define the role of **genomics in the agriculture and agri-food sector**. The strategy will be used as a roadmap to identify future priorities for investment as well as to promote sector engagement and development, and identify potential areas for collaboration.

We are developing a **Translational Networks Program** to facilitate collaborations and dialogue between researchers and other key stakeholders whose sectors stand to be

transformed by genomics advances. The program is being designed to enhance the GE<sup>3</sup>LS research undertaken by funded large-scale applied research projects, focusing on common challenges and barriers to translating the research into use. This will ensure the effective and responsible translation of innovative genomics applications.

Further, Genome Canada and the Genome Centres are working together to develop a **Regional Priorities Partnership Program** intended to support initiatives that develop genomics research and translation capacity in areas of strategy priority to a region. It is designed to catalyze genomics research and development, build on competitive regional advantages or build capacity in a new priority area, and encourage local industries, the public sector and other stakeholders to further use genomics.

We plan to continue our ongoing support for emerging issues, national and international strategic initiatives, and leading-edge technologies through technology platforms and technology development programs. We will pursue further investments in GAPP and provide funding to engage with sector stakeholders to develop their understanding of the value of genomics to their sector.





# ACTIVE PROJECTS FUNDED

A rigorous competitive process determines which research projects and technology platforms will be funded. Projects are selected through a peer review system that includes an assessment of the scientific merit of the proposal, including its potential social and economic benefits for Canada, and a due diligence review of the proposed management structure, the proposed budget and related financial data, including co-funding.

Reviewers are chosen for their recognized expertise in the science, technology and/or translation arena, and management of large-scale genomics projects. Reviewers are drawn primarily from the international scientific community to ensure that the research we fund is of the highest international standards and to avoid conflict of interest. Over the past year, Genome Canada recruited 153 reviewers from 15 countries. Genome Canada’s board of directors makes the final decision on which applications to fund, based on recommendations received from the international panel of reviewers.

All Genome Canada-funded projects are actively monitored by the Genome Centres through different mechanisms, depending on the nature of the funding program and the type of project.

Typically, research oversight committees are created by Genome Canada for each funded large-scale research project. These committees assess the progress of the project, provide oversight and advice, and make recommendations regarding continued funding.

Table 1: Active Projects 2016-17 (see page 26) lists active research projects and technology platforms for which funds flowed in the 2016-17 fiscal year. The table shows the total funding, including the required co-funding, as well as the contribution from Genome Canada. Of the active projects and platforms, 43 started their funding in 2016-17.

# LARGE-SCALE science



Table 1: Active Projects 2016-17

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
<b>LARGE-SCALE APPLIED RESEARCH PROJECTS</b>						
Génome Québec	Agriculture	François Belzile Richard Bélanger	Université Laval	SoyaGen: Improving yield and disease resistance in short-season soybean	\$8,235,673	\$1,602,591
Genome Prairie	Agriculture	Kristin Bett Bert Vandenberg	University of Saskatchewan	Application of Genomics to Innovation in the Lentil Economy (AGILE)	\$7,892,793	\$1,463,833
Genome Alberta Genome Prairie	Agriculture	Michael Dyck John Harding Bob Kemp	University of Alberta	Application of Genomics to Improve Disease Resilience and Sustainability in Pork Production	\$9,801,714	\$3,799,998
Genome British Columbia Ontario Genomics	Agriculture	Leonard Foster Amro Zayed	University of British Columbia	Sustaining and Securing Canada's Honey Bees using 'Omic Tools	\$7,263,568	\$2,786,531
Génome Québec	Agriculture	Lawrence Goodridge Roger Levesque	McGill University	A Syst-OMICS Approach to Ensuring Food Safety and Reducing the Economic Burden of Salmonellosis	\$9,708,401	\$3,817,861
Genome Alberta Ontario Genomics	Agriculture	Filippo Miglior Paul Stothard	University of Guelph	Increasing Feed Efficiency and Reducing Methane Emissions through Genomics: A new promising goal for the Canadian dairy industry	\$10,306,910	\$3,798,134
Genome Prairie Genome British Columbia	Agriculture	Andrew Potter Robert Hancock	VIDO-InterVac University of Saskatchewan	Reverse Vaccinology Approach for the Prevention of Mycobacterial Disease in Cattle	\$7,358,606	\$2,872,310
Genome Prairie	Agriculture	Curtis Pozniak Andrew Sharpe	University of Saskatchewan	Canadian Triticum Applied Genomics (CTAG2)	\$8,809,640	\$1,707,991
Genome British Columbia	Agriculture	Loren Rieseberg John Burke	University of British Columbia	Genomics of Abiotic Stress Resistance in Wild and Cultivated Sunflowers	\$7,879,009	\$3,054,485
Genome Alberta	Agriculture	Paul Stothard Stephen Miller Stephen Moore	University of Alberta	Whole Genome Selection through Wide Imputation in Beef Cattle	\$8,241,119	\$3,860,665
Genome British Columbia Genome Alberta	Forestry	Sally Aitken Sam Yeaman Richard Hamelin	University of British Columbia	CoAdapTree: Healthy trees for future climates	\$5,800,000	\$1,881,454
Génome Québec Genome Prairie	Environment	Niladri Basu Markus Hecker Doug Crump	McGill University	EcoToxChip: A toxicogenomics tool for chemical prioritization and environmental management	\$9,786,922	\$3,104,002
Genome British Columbia Génome Québec	Forestry	Joerg Bohlmann Jean Bousquet	University of British Columbia	Spruce-Up: Advanced spruce genomics for productive and resilient forests	\$10,417,352	\$3,000,000

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Genome British Columbia Génome Québec	Fisheries	Willie Davidson Louis Bernatchez	Simon Fraser University	Enhancing Production in Coho: Culture, community, catch (EPIC4)	\$9,709,592	\$3,796,910
Genome Alberta Genome Atlantic	Energy	Lisa Gieg John Wolodko Faisal Khan	University of Calgary	Managing Microbial Corrosion in Canadian Offshore and Onshore Oil Production Operations	\$7,850,739	\$2,307,750
Genome British Columbia Génome Québec	Forestry	Richard Hamelin Cameron Duff Ilga Porth	University of British Columbia	BioSurveillance of Alien Forest Enemies (BioSAFE)	\$8,730,760	\$2,763,989
Genome Alberta Genome Prairie	Environment	Casey Hubert Gary Stern	University of Calgary	GENICE: Microbial genomics for oil spill preparedness in Canada's arctic marine environment	\$10,612,988	\$2,999,422
Ontario Genomics	Environment	Stephen Lougheed Peter van Coeverden de Groot Graham Whitelaw Markus Dyck	Queen's University	BEARWATCH: Monitoring impacts of Arctic climate change using polar bears, genomics and traditional ecological knowledge	\$9,219,247	\$2,708,282
Ontario Genomics Genome British Columbia	Forestry	Emma Master Harry Brumer	University of Toronto	SYNBIOMICS: Functional genomics and techno-economic models for advanced biopolymer synthesis	\$9,989,427	\$2,830,781
Genome Alberta	Environment	Debbie McKenzie David Wishart	University of Alberta	Systems Biology and Molecular Ecology of Chronic Wasting Disease	\$11,500,523	\$3,092,335
Génome Québec	Environment	Sébastien Sauvé Jesse Shapiro Sarah Dorner	Université de Montréal	Algal Blooms, Treatment, Risk Assessment, Prediction and Prevention through Genomics (ATRAPP)	\$12,304,536	\$3,166,666
Genome British Columbia	Environment	Patricia Schulte Ben Koop Anthony Farrell	University of British Columbia	Sustaining Freshwater Recreational Fisheries in a Changing Environment	\$4,386,173	\$1,460,163
Genome Alberta Genome British Columbia	Forestry	Barb Thomas Nadir Erbilgin Yousry El-Kassaby	University of Alberta	Resilient Forests RES-FOR: Climate, pests and policy – Genomic applications	\$5,678,657	\$1,762,342
Ontario Genomics	Fisheries	Virginia Walker Stephen Lougheed Stephan Schott Peter van Coeverden de Groot	Queen's University	Towards a Sustainable Fishery for Nunavummiut	\$5,652,792	\$2,124,674
Ontario Genomics	Environment	Lesley Warren Jillian Banfield	University of Toronto	Mine Wastewater Solutions: Next generation biological treatment through functional genomics	\$3,682,691	\$1,181,739
Ontario Genomics	Health	Kym Boycott Alex MacKenzie	Children's Hospital of Eastern Ontario	Enhanced CARE for RARE Genetic Diseases in Canada	\$11,778,890	\$2,425,000
Genome British Columbia	Health	Joseph Connors Marco Marra Randy Gascoyne	BC Cancer Agency	Personalized Treatment of Lymphoid Cancer: British Columbia as model province	\$10,232,799	\$2,732,796
Génome Québec Ontario Genomics	Health	Patrick Cossette Jacques Michaud Berge Minassian	Centre hospitalier de l'Université de Montréal	Personalized Medicine in the Treatment of Epilepsy	\$11,509,053	\$5,585,410



**Genome**Canada

GLOBAL CHALLENGES  GENOMIC SOLUTIONS



The genome of Ward the beaver was sequenced at The Centre for Applied Genomics (Hospital for Sick Children) as a gift for Canada's 150<sup>th</sup> anniversary!



CANADA 150

# LARGE-SCALE science



CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Genome British Columbia	Health	Richard Harrigan Julio Montaner	British Columbia Centre for Excellence in HIV/AIDS, St. Paul's Hospital	Viral and Human Genetic Predictors of Response to HIV Therapies	\$4,758,743	\$1,103,367
Génome Québec	Health	Nada Jabado Jacek Majewski Tomi Pastinen	McGill University Health Centre	The ICHANGE (International Childhood Astrocytomas iNtegrated Genomics and Epigenomics) Consortium	\$5,122,390	\$1,230,661
Genome Alberta	Health	Christopher McCabe Tania Bubela	University of Alberta	PACE'Omics: Personalized, accessible, cost-effective applications of 'omics technologies	\$4,502,084	\$1,049,258
Genome British Columbia Genome Alberta	Health	Andrew Penn Christoph Borchers Shelagh Coutts	Vancouver Island Health Authority	Reducing Stroke Burden with Hospital-Ready Biomarker Test for Rapid TIA Triage	\$9,634,996	\$4,755,969
Génome Québec	Health	Claude Perreault Denis-Claude Roy	Université de Montréal Hôpital Maisonneuve-Rosemont	Personalized Cancer Immunotherapy	\$13,486,784	\$2,409,386
Génome Québec	Health	John Rioux Alain Bitton	Montreal Heart Institute	IBD Genomic Medicine Consortium (iGenoMed): Translating genetic discoveries into a personalized approach to treating the inflammatory bowel diseases	\$9,966,018	\$2,460,036
Génome Québec Genome British Columbia	Health	François Rousseau Sylvie Langlois	Université Laval	PEGASUS: Personalized genomics for prenatal aneuploidy screening using maternal blood	\$10,525,682	\$2,475,010
Génome Québec	Health	Guy Sauvageau Josée Hébert	Institute for Research in Immunology and Cancer	Innovative Chemogenomic Tools to Improve Outcome in Acute Myeloid Leukemia	\$11,325,631	\$4,908,515
Ontario Genomics	Health	Stephen Scherer Peter Szatmari	The Hospital for Sick Children	Autism Spectrum Disorders: Genome to outcomes	\$9,979,998	\$2,479,999
Génome Québec	Health	Jacques Simard Bartha Maria Knoppers	Université Laval	Personalized Risk Stratification for Prevention and Early Detection of Breast Cancer	\$11,761,246	\$2,732,295
Genome British Columbia	Health	Don Sin Raymond Ng	St. Paul's Hospital, University of British Columbia PROOF Centre for Excellence	Clinical Implementation and Outcomes Evaluation of Blood-Based Biomarkers for COPD Management	\$7,100,000	\$1,700,000
Ontario Genomics	Health	Lincoln Stein Tony Godfrey	Ontario Institute for Cancer Research	Early Detection of Patients at High Risk of Esophageal Adenocarcinoma	\$3,240,865	\$795,272
Ontario Genomics	Health	Alain Stintzi Dave Mack	University of Ottawa	The Microbiota at the Intestinal Mucosa-Immune Interface: A gateway for personalized health	\$2,961,445	\$716,360

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Génome Québec	Health	Jean-Claude Tardif Marie-Pierre Dubé	Montreal Heart Institute	Personalized Medicine Strategies for Molecular Diagnostics and Targeted Therapeutics of Cardiovascular Diseases	\$9,443,002	\$4,672,882
<b>EMERGING ISSUES</b>						
Genome Alberta	Agriculture	Alexander Zakhartchouk Volker Gerdts	University of Saskatchewan	Development of a New Generation of Modified Live Virus Vaccine for PEDv using Reverse Genetics System	\$695,500	\$237,144
Genome Alberta	Agriculture	John Harding Soren Alexandersen	University of Saskatchewan	Enhanced Molecular Diagnostics and Validating Genetic Resistance to PEDv in pigs	\$325,917	\$118,928
Genome Prairie	Health	Uladzimir Karniychuk	University of Saskatchewan	In Vivo and Ex Vivo Models for Zika Virus Infection	\$713,062	\$237,436
<b>NATIONAL AND INTERNATIONAL INITIATIVES</b>						
Genome Alberta	Health	Gregory Cairncross	University of Calgary	Modeling and Therapeutic Targeting of the Clinical and Genetic Diversity of Glioblastoma	\$8,178,786	\$612,000
Genome Alberta Génome Québec	Health	Christopher McCabe François Rousseau	University of Alberta	Genomics and Personalized Health GE <sup>3</sup> LS Network program	\$1,996,945	\$998,473
Ontario Genomics Genome Alberta	Health	Peter Dirks Samuel Weiss	The Hospital for Sick Children	Brain Cancer Stem Cell Dream Team	\$10,577,948	\$8,500,000
Genome British Columbia	Health	Shubhayan Sanatani	BC Children's Hospital	Improving Diagnosis and Treatment of Catecholaminergic Polymorphic Ventricular Tachycardia	\$4,640,290	\$333,000
Ontario Genomics	Health	Michael Brudno	The Hospital for Sick Children	Harmonising Phenomics Information for a Better Interoperability in the RD Field	\$4,429,833	\$333,000
Ontario Genomics	Health	Eleftherios Diamandis	University of Toronto	Netherton Syndrome: From mechanisms to therapies	\$4,358,669	\$333,000
Ontario Genomics	Health	Aled Edwards Cheryl Arrowsmith	University of Toronto	Structural Genomics Consortium IV	\$20,519,808	\$2,275,273
Ontario Genomics	Health	Lincoln Stein	University of Toronto	Advancing Big Data Science in Genomics Research Project – The cancer genome collaborative	\$5,999,860	\$2,000,000
Genome British Columbia	Health	Brett Finlay Janet Rossant	University of British Columbia	Canadian Humans and the Microbiome Program CIFAR	\$5,775,000	\$1,000,000
Génome Québec Ontario Genomics Genome British Columbia	Health	Bartha Maria Knoppers Michael Brudno Jan Friedman	McGill University	Canadian International Data Sharing Initiative CanSHARE	\$3,287,331	\$1,000,000
Génome Québec	Health	Ruthanne Huising	McGill University	Responsible Innovation: Altering professional accountability for biosafety and biosecurity	\$129,348	\$64,674

## LEADING-EDGE

# technology



CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
<b>GENOMICS INNOVATION NETWORK – CORE OPERATIONS SUPPORT FOR TECHNOLOGY PLATFORMS</b>						
Genome Alberta Genome British Columbia	All	David Wishart Christoph Borchers	University of Alberta University of Victoria	The Metabolomics Innovation Centre	\$2,041,461	\$2,041,461
Genome British Columbia	All	Christoph Borchers Leonard Foster	University of Victoria University of British Columbia	The Proteomics Centre	\$2,262,274	\$2,262,274
Genome British Columbia	All	Rob Holt Marco Marra	BC Cancer Agency	Sequencing Platform at the BC Cancer Agency Genome Sciences Centre	\$2,314,427	\$2,314,427
Génome Québec Ontario Genomics	All	Philip Awadalla Lincoln Stein Isabelle Fortier Vincent Ferretti	Centre hospitalier universitaire Sainte-Justine University of Toronto	Canadian Data Integration Centre	\$1,019,078	\$1,019,078
Génome Québec Ontario Genomics	All	Guillaume Bourque Michael Brudno	McGill University The Hospital for Sick Children	Canadian Centre for Computational Genomics	\$1,053,791	\$1,053,791
Génome Québec	All	Mark Lathrop Ioannis Ragoussis Guillaume Bourque Tommi Pastinen	McGill University	McGill University and Génome Québec Innovation Centre	\$2,188,356	\$2,188,356
Génome Québec	All	Pierre Thibault Michael Tyers	Université de Montréal	Centre for Advanced Proteomics Analyses	\$756,674	\$756,674
Ontario Genomics	All	Colin McKelvie	The Hospital for Sick Children	Toronto Centre for Phenogenomics	\$1,222,983	\$1,222,983
Ontario Genomics	All	Stephen Scherer Lisa Strug	The Hospital for Sick Children	The Centre for Applied Genomics	\$2,068,725	\$2,068,725
Ontario Genomics	All	Jeff Wrana Anne-Claude Gingras	Mount Sinai Hospital	Network Biology Collaborative Centre	\$974,939	\$974,939
<b>GENOMICS INNOVATION NETWORK – TECHNOLOGY DEVELOPMENT PROJECTS</b>						
Genome Alberta Genome British Columbia	All	David Wishart Christoph Borchers	University of Alberta University of Victoria	The Metabolomics Innovation Centre	\$1,856,377	\$938,790
Genome British Columbia	All	Christoph Borchers Leonard Foster	University of Victoria University of British Columbia	The Proteomics Centre	\$2,070,256	\$999,815
Genome British Columbia	All	Rob Holt Marco Marra	BC Cancer Agency	Sequencing Platform at the BC Cancer Agency Genome Sciences Centre	\$2,000,000	\$999,586
Génome Québec Ontario Genomics	All	Guillaume Bourque Michael Brudno	McGill University The Hospital for Sick Children	Canadian Centre for Computational Genomics	\$1,062,606	\$526,895

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Génome Québec	All	Mark Lathrop Ioannis Ragoussis Guillaume Bourque Tomi Pastinen	McGill University	McGill University and Génome Québec Innovation Centre	\$3,293,977	\$761,522
Ontario Genomics	All	Colin McKerlie	The Hospital for Sick Children	Toronto Centre for Phenogenomics	\$1,018,748	\$501,933
Ontario Genomics	All	Stephen Scherer Lisa Strug	The Hospital for Sick Children	The Centre for Applied Genomics	\$1,487,169	\$743,196
Ontario Genomics	All	Jeff Wrana Anne-Claude Gingras	Mount Sinai Hospital	Network Biology Collaborative Centre	\$905,892	\$452,360
<b>GENOMICS INNOVATION NETWORK – COLLABORATIVE PROJECT</b>						
Genome British Columbia	Health	Martin Hirst	University of British Columbia	Canadian Epigenetics, Environment and Health Research Consortium Network	\$2,000,000	\$1,000,000
<b>BIOINFORMATICS AND COMPUTATIONAL BIOLOGY</b>						
Ontario Genomics	Agriculture	Nicholas Provart	University of Toronto	ePlants Pipeline and Navigator for Accessing and Integrating Multi-Level 'Omics Data for 15 Agronomically Important Species for Hypothesis Generation	\$250,000	\$250,000
Ontario Genomics	Agriculture	Nicholas Provart Stephen Wright	University of Toronto	Large Data Sets and Novel Tools for Plant Biology for use in International Consolidation – Tier data repositories and portals	\$999,996	\$499,998
Génome Québec	Agriculture	Mathieu Blanchette Thomas Bureau	McGill University	PIATEA: A portal for integrative approaches to transportable element annotation	\$249,915	\$62,478
Genome Atlantic Ontario Genomics	Health	Rob Beiko Andrew McArthur	Dalhousie University	Rapid Prediction of Antimicrobial Resistance from Metagenomics Samples: Data, models and methods	\$249,985	\$116,661
Genome British Columbia	Health	Inanc Birol	BC Cancer Agency	New Bioinformatics for New Sequencing Technologies: Genome characterization and variation detection using long reads	\$250,000	\$116,668
Genome British Columbia	Health	Ryan Brinkman Cedric Chauve Sara Mostafavi	BC Cancer Agency	Automated Analysis of Big Flow Cytometry Data	\$249,994	\$118,762
Genome British Columbia	Health	Leonid Chindelevitch William Hsiao Cedric Chauve	Simon Fraser University	PathOGiST: Calibrated multi-criterion genomic analysis for public health microbiology	\$250,000	\$116,668
Genome British Columbia Ontario Genomics	Health	William Hsiao Andrew McArthur Fiona Brinkman	University of British Columbia	Genomic Epidemiology Application Ontology GenEpiO	\$250,000	\$116,668
Genome British Columbia	Health	Wyeth Wasserman	University of British Columbia	OnTarget: Big data informed software for the design of cis-regulatory regions controlling human gene expression	\$250,000	\$116,709

# LEADING-EDGE technology

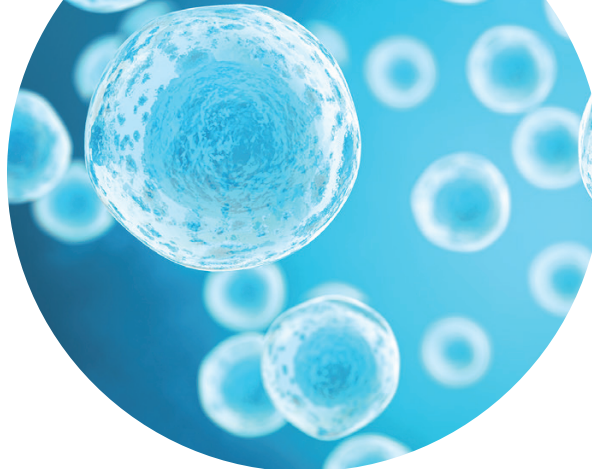


CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Génome Québec	Health	François Major Thomas Duchaine	Université de Montréal	Computation of Cell-Specific MicroRNA: mRNA regulatory networks enable the design of efficient RNAi-based therapeutics	\$250,000	\$116,668
Génome Québec	Health	Jesse Shapiro Luis Barreiro	Université de Montréal	A Toolkit for Genome-Wide Association Studies in Bacteria	\$250,000	\$116,668
Génome Québec	Health	Jerome Waldispuhl Nicolas Moitessier	McGill University	Computational Methods and Databases to Identify Small RNA-binding Molecules Regulating Gene Expression	\$249,999	\$116,868
Génome Québec Genome Prairie	Health	Jerome Waldispuhl Olivier Tremblay-Savard	McGill University	Crowdsourcing Genomic Databases	\$250,000	\$116,668
Ontario Genomics	Health	Paul Boutros	Ontario Institute for Cancer Research	Enhanced and Automated Visualization of Complex Data	\$250,000	\$116,668
Ontario Genomics	Health	Michael Brudno Rebecca Weksberg	The Hospital for Sick Children	Consolidated Epigenetic Landscape for Congenital, Developmental and Childhood Disorders	\$249,900	\$117,577
Ontario Genomics	Health	Vincent Ferretti Lincoln Stein	Ontario Institute for Cancer Research	Dockstore: A platform for sharing cloud-agnostic tools with the research community	\$250,000	\$116,668
Ontario Genomics	Health	Art Poon	Western University	Kamphir: A versatile framework to fit models to phylogenetic tree shapes	\$205,365	\$91,033
Ontario Genomics	Health	Jared Simpson	Ontario Institute for Cancer Research	Rapid, Accessible Genome Assembly Using Long Read Sequencing	\$250,000	\$116,668
Genome British Columbia	Health	Inanc Birol Steven Jones Aly Karsan	BC Cancer Agency	Next Generation Bioinformatics for Clinical Genomics: Using <i>de novo</i> assembly in personalized medicine	\$999,867	\$499,928
Genome British Columbia Genome Prairie	Health	Fiona Brinkman Gary Van Domselaar William Hsiao	Simon Fraser University	A Federated Bioinformatics Platform for Public Health Microbial Genomics	\$1,562,534	\$499,108
Genome British Columbia	Health	Sohrab Shah	University of British Columbia	Measuring and Modeling Tumour Evolution from Next Generation Sequencing Data: Enabling clinical study of clonal diversity in cancer patients	\$999,759	\$499,547
Genome British Columbia	Health	Wyeth Wasserman	University of British Columbia	Applied Bioinformatics of Cis-regulation for Disease Exploration (ABC4DE)	\$1,000,000	\$500,000

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Ontario Genomics	Health	Michael Brudno Gary Bader	The Hospital for Sick Children	MedSavant: An integrative framework for clinical and research analysis of human genomes	\$998,546	\$499,273
Ontario Genomics	Health	Jordan Lerner-Ellis Matthew Lebo	Mount Sinai Hospital	Development of a Unified Canadian Clinical Genomic Database as a Community Resource for Standardizing and Sharing Genetic Interpretations	\$1,000,000	\$500,000
Génome Québec	Health	Jerome Waldispuhl Mathieu Blanchette	McGill University	A Development and Deployment Platform for Citizen Science Games in Genomics	\$249,318	\$62,329
DISRUPTIVE INNOVATION IN GENOMICS						
Genome British Columbia	All	Fraser Hof	University of Victoria	A Chemo-Affinity Toolkit for Methylation Proteomics	\$238,800	\$238,800
Genome British Columbia	All	Sohrab Shah Cydney Nielsen	University of British Columbia	Reimagining Genome Browsing for the Era of Single Cell Genomics	\$250,000	\$250,000
Genome British Columbia	All	Wyeth Wasserman	University of British Columbia	GNomics: Graphs 'n' omics	\$250,000	\$250,000
Génome Québec	All	Santiago Costantino Claudia Kleinman	McGill University	Laser Assisted Single-Cell Genomics	\$250,000	\$250,000
Génome Québec	All	David Juncker	McGill University	Single Exosome Multi-Omic Analysis	\$249,999	\$249,999
Génome Québec	All	Eric Lécuyer Mathieu Blanchette Jérôme Waldispuhl	Institut de recherches cliniques de Montréal	The RNA Zipcode Discovery Pipeline: Emerging tools for targeting therapeutic molecules at subcellular resolution	\$250,000	\$250,000
Génome Québec	All	Mark Trifiro Andrew Kirk	McGill University	Plasmonic PCR: Rapid diagnostics through plasmonics	\$249,976	\$249,976
Génome Québec Ontario Genomics	All	Michael Tyers Gerard Wright	Université de Montréal	A Cell Microfactory Platform for In Vivo Biosynthesis and Delivery of Genetically Encoded Natural Products and Synthetic Antibodies	\$249,358	\$249,358
Ontario Genomics	All	Charles Boone Jason Moffat	University of Toronto	AbSyn Technology for Identification of Synergistic Cancer Therapeutics	\$249,389	\$249,389
Ontario Genomics	All	James Dowling Michael Brudno	The Hospital for Sick Children	RNA-seq in Patient-Derived Ex-Vivo Models: Genetic diagnostics beyond whole exomes	\$250,000	\$250,000
Ontario Genomics	All	Andrew Emili	University of Toronto	Massively Parallel Single Molecule Protein Sequencing in Situ	\$250,000	\$250,000
Ontario Genomics	All	Daniel Figeys Alain Stintzi	University of Ottawa	RapidAIM: A high-throughput assay of individual microbiome	\$250,000	\$250,000
Ontario Genomics	All	Turlough Finan	McMaster University	Development of Advanced Genetic Toolbox for Sinorhizobium Meliloti to Enable Genome Scale Engineering	\$250,000	\$250,000

## LEADING-EDGE

# technology



CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Ontario Genomics	All	Peter Krell Daniel Doucet	University of Guelph	Cell Biosensors for Rapid Screening of Insect Attractants	\$233,901	\$233,901
Ontario Genomics	All	Stephen Scherer Si Lok	The Hospital for Sick Children	Economical High Throughput <i>De Novo</i> Whole Genome Assembly	\$241,467	\$241,467
Ontario Genomics	All	Igor Stagljär	University of Toronto	Development of SIMPL, a Novel Protein-Protein Interaction Assay based on Split Intein for Biomedical Research	\$250,000	\$250,000
Ontario Genomics	All	Vincent Tabard-Cossa	University of Ottawa	Solid-State Nanopore-based Quantification of Low-Abundance Biomarkers	\$250,000	\$250,000
Ontario Genomics	All	Michael Taylor Rama Khokha	The Hospital for Sick Children	Functional Genomics in Human Cells for Drivers of Lethal Metastatic Human Cancers	\$250,000	\$250,000
Ontario Genomics	All	Aaron Wheeler Elena Kolomietz	University of Toronto	Development of a Digital Microfluidic Platform to Identify and Target Single Cells from a Heterogeneous Cell Population for Lyses in an Ultra-Low Volume	\$250,000	\$250,000
Ontario Genomics		Michael Wilson Adam Shlien	University of Toronto	SANGRE Systematic Analysis of Blood Gene Regulation by Sequencing – Bringing RNA-seq to clinical diagnostics	\$249,934	\$249,934
Genome British Columbia	All	Christoph Borchers Albert Sickmann	University of Victoria	Replacing Immunoassays with MS-based Technology: Quantitative proteomics kits enabling deep molecular phenotyping of the mouse	\$3,865,231	\$999,695
Genome British Columbia	All	Carl Hansen	University of British Columbia	Next Generation Immune Profiling Technology based on Microfluidic Single Cell Analysis	\$2,993,509	\$991,185
Genome British Columbia	All	Marco Marra Robin Coope	BC Cancer Agency	Automated Tumour Pathology	\$409,858	\$101,559
Ontario Genomics	All	Sachdev Sidhu	University of Toronto	Synthetic Inhibitors of Ubiquitin-Binding Cancer Targets	\$3,009,018	\$1,000,000
Ontario Genomics	All	Igor Stagljär	University of Toronto	The Mammalian Membrane Two-Hybrid MaMTH Assay – An advanced proteomics technology for biomedical research	\$3,000,000	\$1,000,000



# TRANSLATION

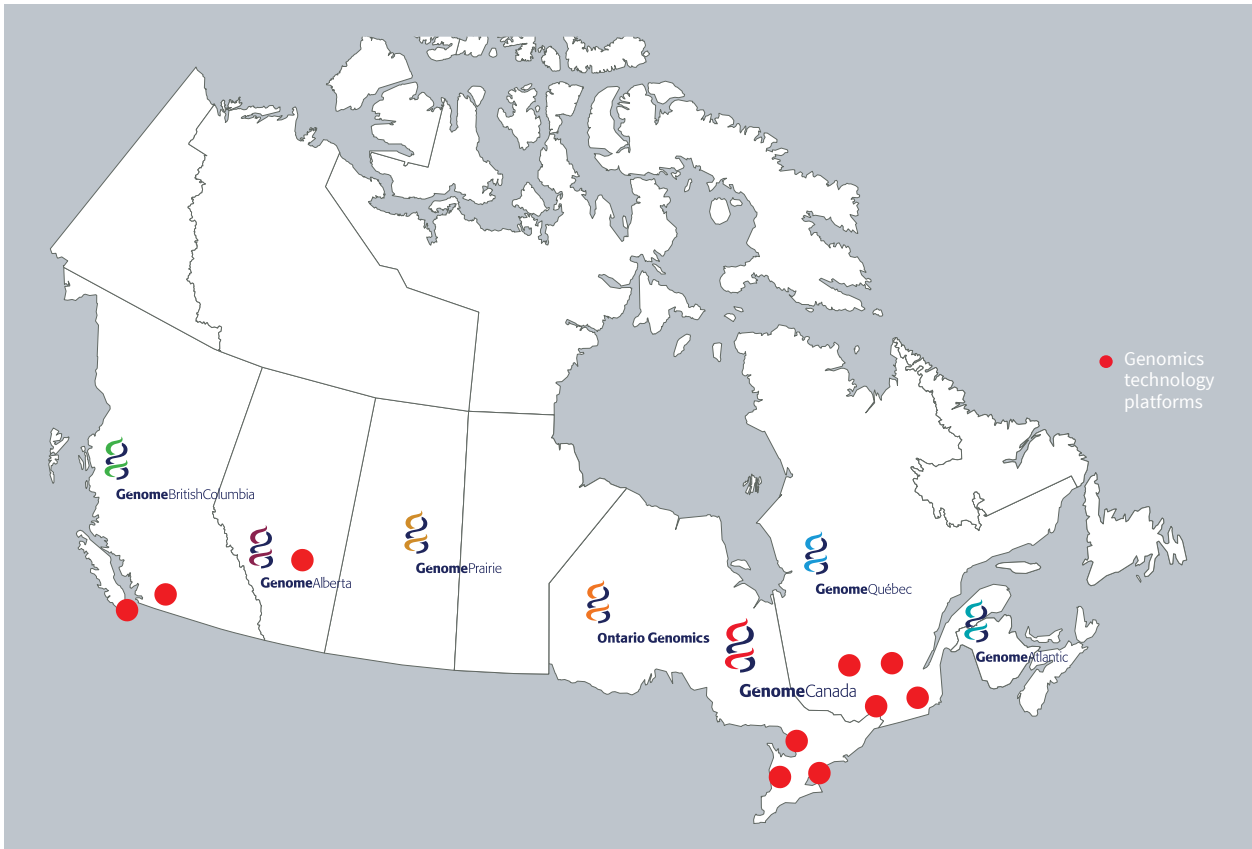
CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
<b>GENOMIC APPLICATIONS PARTNERSHIP PROGRAM</b>						
Génome Québec	Agriculture	Adrian Tsang Paul Matzat	Concordia University Elanco Animal Health	Development and Commercialization of Next Generation Enzyme Supplement for Swine and Poultry	\$6,000,000	\$2,000,000
Genome Alberta	Agriculture	Jocelyn Ozga Vic Knauf	University of Alberta Arcadia Biosciences	Application of Genomics for Increasing Seed Oil Content in Soybean	\$339,287	\$113,000
Genome Prairie	Agriculture	Jocelyn Ozga M. Tahir	University of Alberta Dow Agrosciences Canada Inc.	Enhancement of Commercial Utilization of Canola Oil and Meal by Manipulation of Cellular and Sub-Cellular Metabolism Involving Fats and Carbohydrates	\$961,392	\$320,000
Ontario Genomics Génome Québec	Agriculture	Charles Goulet David Liscombe	Université Laval Vineland Research and Innovation Centre	A Genetic Toolbox for Tomato Flavour Differentiation	\$1,804,643	\$601,533
Génome Québec	Agriculture	Claude Robert Brian Sullivan	Université Laval Canadian Centre for Swine Improvement	Chips for Better Chops: Commercial application of genomics for accelerated swine genetic improvement	\$6,550,103	\$1,996,186
Genome Prairie	Agriculture	Vladimir Vujanovic Ray Riley	University of Saskatchewan Indigo Agriculture	Augmenting the Plant Microbiome to Improve Crop Yield and Stress Resilience	\$16,143,997	\$1,943,373
Génome Québec	Agriculture	Steve Labrie Manon Duquenne	Université Laval Agropur Cooperative	A Metagenomic Approach to Evaluate the Impact of Cheesemaking Technologies and Ripening Conditions on the Microbial Ecosystem of Premium Washed Rind Cheeses	\$742,679	\$247,472
Ontario Genomics	Agriculture	Keik Yoshioka Daryl Somers	University of Toronto Vineland Research and Innovation Centre	Genomics for a Competitive Greenhouse Vegetable Industry	\$2,416,624	\$802,648
Genome Atlantic Genome Alberta	Energy	Casey Hubert Adam MacDonald	University of Calgary Nova Scotia Department of Energy	Microbial Genomics for De-Risking Offshore Oil and Gas Exploration in Nova Scotia	\$4,886,764	\$1,597,843
Genome Prairie	Environment	David Levin Shawna Ducharme	University of Manitoba Composites Innovation Centre	Fibre Composite and Biomatrix Genomics FiCoGEN – Application to the ground transportation industry	\$3,315,000	\$1,105,000

## TRANSLATION



CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Ontario Genomics	Fisheries	Elizabeth Edwards Sandra Dworatzek	University of Toronto SiREM	Scale-up of Bioaugmentation Cultures and Development of Delivery Strategies and Monitoring Tools for Anaerobic Benzene and Alkylbenzene Bioremediation	\$952,497	\$317,422
Genome Atlantic	Fisheries	Matthew Rise Richard Taylor	Memorial University Cargill Aqua Nutrition	Biomarker Platform for Commercial Aquaculture Feed Development	\$3,804,456	\$1,093,988
Genome Atlantic	Fisheries	Matthew Rise Richard Taylor	Memorial University EWOS Innovation	Integrated Pathogen Management of Co-infection in Atlantic Salmon	\$4,533,102	\$1,509,113
Genome Atlantic Ontario Genomics	Forestry	Elizabeth Boulding Keng Pee Ang	University of Guelph Cooke Aquaculture Inc.	SALMON and CHIPS – Commercial application of genomics to maximize genetic improvement of farmed Atlantic salmon on the East Coast of Canada	\$3,797,739	\$1,265,930
Genome British Columbia Génome Québec	Forestry	Richard Hamelin Cameron Duff	University of British Columbia Canadian Food Inspection Agency	Protecting Canada's Forests against Invasive Alien Species by Next Generation Biosurveillance	\$2,430,000	\$810,000
Génome Québec	Forestry	Jean Bousquet Guy Smith	Université Laval FPIInnovations	Fact Tests for Rating and Amelioration of Conifers FastTRAC	\$3,364,420	\$1,122,043
Genome British Columbia	Health	Joerg Bohlmann John H. Russell	University of British Columbia British Columbia Ministry of Forests, Lands and Natural Resource Operations	Cedar Enhanced Durability and Resistance CEDaR: Sustainability of Canada's western redcedar forestry sector	\$2,150,779	\$716,811
Genome British Columbia	Health	Christoph Borchers Claude Leduc	University of Victoria MRM Proteomics Inc.	Development of Disease Biomarker Assessment Assays and Kits for Targeted Quantitative Proteomics of Mouse Plasma by Mass Spectrometry	\$1,238,513	\$412,637
Ontario Genomics	Health	James Kennedy Bryan Dechairo	Centre for Addiction and Mental Health Assurex Health Inc.	Clinical Utility and Enhancements of a Pharmacogenomic Decision Support Tool for Mental Health Patients	\$5,994,758	\$1,981,184
Ontario Genomics	Health	Peter Liu Gabriela Bucklar-Suchankova	University of Ottawa Heart Institute Roche Diagnostics International	Cardiovascular Biomarker Translation CBT Program	\$5,904,662	\$1,953,663

CENTRES	SECTOR	LEADERS	ORGANIZATIONS	TITLE	TOTAL FUNDING	GENOME CANADA CONTRIBUTION
Ontario Genomics	Health	Paul Van Slyke David Andrews	Vasomune Therapeutics Sunnybrook Health Sciences Centre	Developing Vasculotide, a Genomic/Proteomic Derived Treatment to Target Vascular Inflammation and Destabilization	\$1,500,003	\$500,001
Ontario Genomics	Health	Jean Wang Robert Uger	University Health Network Trillium Therapeutics Inc.	SIRPaFc: Translating genomics research Into a novel cancer immunotherapy	\$3,428,274	\$1,106,079
Ontario Genomics	Health	Suzanne Kamel-Reid Joby McKenzie	Princess Margaret Cancer Center Lifelabs Medical Laboratory Services	Towards a National Framework for Cancer Genome Profiling in Canadian Hospitals	\$6,000,000	\$1,999,999
Ontario Genomics	Health	Shaf Keshavjee Thomas Hartnett	University Health Network United Therapeutics	Novel Rapid Diagnostic Tools for Lung Transplantation: Bringing omics to the bedside	\$6,000,000	\$2,000,000
Génome Québec	Health	Michel Bergeron Patrice Allibert	Université Laval GenePOC Inc.	Expanding the Molecular Point-Of-Care Test Menu with Two Gram-Positive Cocci	\$5,711,781	\$1,740,577
Génome Québec Genome British Columbia	Health	Christoph Borchers Gerald Batist Paul Elvin	McGill University University of Victoria AstraZeneca	Second Generation Diagnostics: iMALDI-based assays for protein activity to improve patient selection for therapeutic Akt inhibitors in cancer treatment	\$3,340,335	\$806,285
Ontario Genomics	Health	Xiao-Yen Wen R. Loch MacDonald	St. Michael's Hospital Edge Therapeutics	Preclinical Development of Drugs for Intracerebral Hemorrhage ICH	\$5,948,000	\$1,982,667
Génome Québec	Health	Pierre Thibault Jean-Jacques Dunyach	Université de Montréal Thermo Fisher Scientific	Bridging the ProteoGenomics Gap for Personalized Medicine using Transformative Mass Spectrometry Technologies	\$1,737,722	\$522,730
Ontario Genomics	Health	Cynthia Hawkins John Racher Barney Saunders	The Hospital for Sick Children Nanostring Technologies	Clinical Development and Translation of Genomics-Driven Pediatric Cancer Diagnostics using NanoString Technology	\$1,865,739	\$600,000
Ontario Genomics	Health	David Stewart Craig Ivany	Ottawa Hospital Research Institute Eastern Ontario Regional Laboratory Association	Standardization of Molecular Diagnostic Testing for Non-small Lung Cancer	\$2,054,798	\$595,197
Ontario Genomics	Health	Shana Kelley Jack Graham	University of Toronto Xagenic	Development of Low Cost Diagnostic Platform for Infectious Disease Testing	\$5,976,619	\$1,979,494
<b>ENTREPRENEURSHIP EDUCATION</b>						
Genome British Columbia	Health	Angus Livingstone Daniel Muzyka	University of British Columbia	Genomics Research Entrepreneurship to Accelerate Translation (GREAT)	\$979,965	\$408,789



# GENOMICS **ENTERPRISE**

Genome Canada operates within a unique and highly effective model. It works collaboratively with six regional Genome Centres, each of which is independently incorporated, in pursuit of agreed-to objectives in genomics research. This approach enables national breadth and regional depth, ensuring collective, pan-Canadian action in determining priorities and delivering programs.

The Genome Centres play a significant role on a number of levels. They:

- foster regional expertise in genomics research,
- develop partnerships to strengthen regional leadership and competitiveness,
- facilitate researcher access to the technology platforms,
- create unique and innovative public outreach programs, and
- most importantly, secure co-funding for projects from both domestic and international investors.

The Genome Centres pursue their own strategic objectives informed by regional strengths and priorities. Several of the Genome Centres obtain funding from other sources, primarily provincial governments, to support regionally focused research programs. The operational costs to fulfil the Centres' mandates are supported by many sources of funding, including Genome Canada. In 2016-17, Genome Canada provided \$880,000 each to Génome Québec, Ontario Genomics and Genome British Columbia, and \$734,800 each to Genome Atlantic, Genome Prairie and Genome Alberta. As recipients of Genome Canada funding, the Genome Centres are subject to regular external assessments.

# GOVERNANCE

Genome Canada is governed by a board of directors comprising no less than nine, but not more than 16, directors. The directors are recruited from the academic, private and public sectors and offer a range of expertise, including genomics research, genomics in society, bioinformatics, academia, the government sector, business, commercialization and communications. New directors are appointed for two-year terms that are renewable. The presidents of each of the following organizations – the Canada Foundation for Innovation, Canadian Institutes of Health Research, National Research Council Canada, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada – are non-voting, ex officio advisers to the board.

The board has stewardship over the business and affairs of Genome Canada. Its fiduciary responsibilities include strategic leadership, succession planning, risk mitigation, performance and evaluation, and financial oversight. A number of permanent committees assist the board in fulfilling its duties:

- an executive committee,
- an audit and investment committee,
- a governance, election and compensation committee,
- a communications and outreach committee, and
- a programs committee.

The board has in place a science and industry advisory committee that provides advice to the board on approaches and directions that contribute to the achievement of Genome Canada's strategic plan. This committee consists of individuals from Canada and abroad who are internationally recognized in the science and industry sectors and in fields relevant to genomics in society.

## NUMBER OF MEETINGS HELD BY THE BOARD AND ITS COMMITTEES IN 2016-17

Board of directors	4
Audit and investment committee	4
Governance, election and compensation committee	4
Communications and outreach committee	4
Programs committee	4
Science and advisory committee	5

## Board directors, ex officio advisors, and science and industry advisory committee members in 2016-17

### BOARD OF DIRECTORS

**Moura Quayle (chair)**

Director *pro tem*, UBC School of Public Policy and Global Affairs  
Professor, Sauder School of Business  
University of British Columbia  
Vancouver, British Columbia

**Jim Farrell (vice-chair)**

Forest sector consultant  
Ottawa, Ontario

**Fiona Brinkman**

Professor of bioinformatics and genomics, Department of Molecular Biology and Biochemistry  
Associate professor at School of Computing Science and at Faculty of Health Sciences  
Simon Fraser University  
Burnaby, British Columbia

**Eric Cook**

Executive director and chief executive officer (CEO)  
Research and Productivity Council  
Fredericton, New Brunswick

**Elizabeth Douville**

General partner  
AmorChem Financial Inc.  
Montreal, Quebec

**Janice Y. Lederman**

Partner, Thompson Dorfman Sweatman LLP (retired)  
President, Innovate Manitoba Inc.  
Winnipeg, Manitoba

**Marc LePage**

President and CEO  
Genome Canada  
Ottawa, Ontario

**Kim McConnell**

Founder and former CEO,  
AdFarm  
Calgary, Alberta

**Eddy Rubin**

Chief science officer,  
Metabiota  
San Francisco, California,  
U.S.A.

**Jacques Simoneau**

President and CEO  
Gestion Univalor  
Montreal, Quebec

**Janet Wightman**

Managing director  
Kincannon & Reed  
Regina, Saskatchewan

**Barbara Wold**

Bren Professor of Molecular Biology  
California Institute of Technology  
Pasadena, California, U.S.A.

**Donald Ziraldo**

Co-founder, Inniskillin  
St. Catharines, Ontario

## EX OFFICIO ADVISORS

### **Ted Hewitt**

President  
Social Sciences and  
Humanities Research Council  
of Canada  
Ottawa, Ontario

### **Alain Beaudet**

(until March 31, 2017)  
President  
Canadian Institutes of Health  
Research  
Ottawa, Ontario

### **Roderick McInnes**

(since April 1, 2017)  
Acting president  
Canadian Institutes of Health  
Research  
Ottawa, Ontario

### **Gilles G. Patry**

President and CEO  
Canada Foundation for  
Innovation  
Ottawa, Ontario

### **B. Mario Pinto**

President  
Natural Sciences and  
Engineering Research Council  
of Canada  
Ottawa, Ontario

### **Iain Stewart**

President  
National Research Council  
of Canada  
Ottawa, Ontario

## SCIENCE AND INDUSTRY ADVISORY COMMITTEE

### **Doane Chilcoat (chair)**

Director, applied technology  
systems  
DuPont Pioneer  
Johnston, Iowa, U.S.A.

### **Robert Beauregard**

Professor, Faculté de  
foresterie, de géographie et  
de géomatique  
Université Laval  
Québec, Québec

### **Anne-Christine Bonfils**

Research program manager,  
vice-president's office – life  
sciences  
National Research Council  
of Canada  
Ottawa, Ontario

### **Joan Lunney**

Supervisory research scientist  
Beltsville Agricultural  
Research Center  
Beltsville, Maryland, U.S.A.

### **Francis Ouellette**

(until February 22, 2017)  
Associate director, senior  
scientist, informatics and bio-  
computing  
Ontario Institute for Cancer  
Research  
Toronto, Ontario

### **Elaine R. Mardis**

Professor of pediatrics,  
The Ohio State University  
College of Medicine  
Co-director, The Institute for  
Genomic Medicine at The  
Research Institute, Nationwide  
Children's Hospital  
Columbus, Ohio, U.S.A.

### **Eric M. Meslin**

President and CEO  
Council of Canadian Academies  
Ottawa, Ontario

### **Dan Roden**

Principal investigator, National  
Institutes of Health (NIH),  
Pharmacogenomics Research  
Network  
NIH, National Human Genome  
Research Institute, Electronic  
Medical Records and Genomics  
Vanderbilt University  
Nashville, Tennessee, U.S.A.

### **Julie Segre**

Senior investigator, NIH, National  
Human Genome Research  
Institute  
Chief, translational and  
functional genomics branch  
Head, microbial genomics  
section  
Bethesda, Maryland, U.S.A.

### **Paul A. Willems**

Technology vice-president,  
Energy Biosciences, BP Group  
Associate director, Energy  
Biosciences Institute, University  
of California – Berkeley  
Berkeley, California, U.S.A.

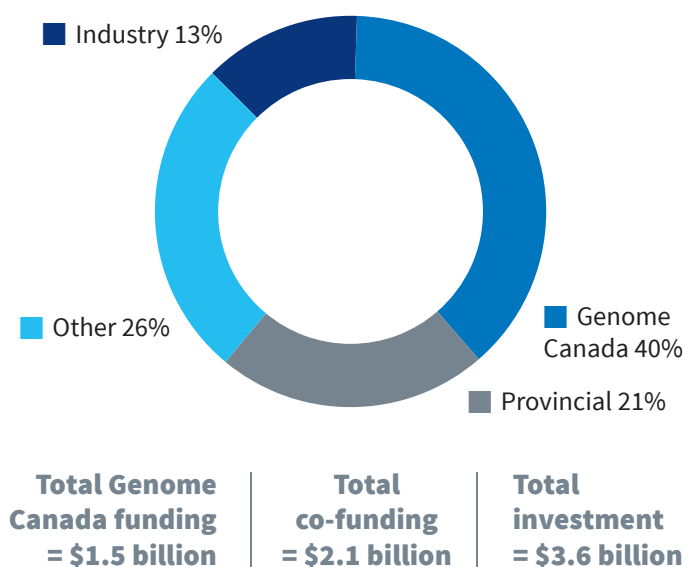
# FINANCIAL MANAGEMENT

Genome Canada has invested \$3.6 billion in genomics research since its creation in 2000. The federal government provided \$1.5 billion, including investment income from this funding. The remaining \$2.1 billion came from national and international partners, including provincial governments, and private and public sector partners. Genome Canada's investments support large-scale science, access to leading-edge technology, translation, and the operations of Genome Canada and the six regional Genome Centres.

All research projects, with few exceptions, require co-funding from other parties, including provincial governments, universities, the private sector, and other national and international organizations. Genome Canada's funding ratio for co-funding was 1:1 prior to 2012. However, it has since increased to approximately 1:1.6.

**Figure 2**

## INVESTMENT BY GENOME CANADA AND PARTNERS FROM 2000-17



Genome Canada receives funding each year from the federal government based on the annual requirements of research projects. This funding goes to the six Genome Centres, which direct the funds to the individual projects located in their regions. In addition, the projects, administered at institutions, receive funding directly from the required co-funders. The Centres and project leaders must report co-funding quarterly to Genome Canada.

The total annual financial investment in projects is shown in the graph below. Genome Canada and the Centres monitor total project investment. Genome Canada project leaders managed \$180 million in funding in 2016-17, comprised of \$55 million from Genome Canada and \$125 million from co-funding.



Genome Canada’s operating costs were \$6.8 million in 2016-17. Operations include activities relating to genomics programs, strategy, fundraising, communications, governance, performance and evaluation, genomics in society and administration.

Genome Canada’s operating costs include the following statement of remuneration. The board of directors and committee members do not receive remuneration for their services; however, Genome Canada pays the expenses incurred by directors in the performance of their duties. For staff of Genome Canada, there is a compensation policy that includes job classifications and related salary ranges. Genome Canada employees are eligible for performance awards of up to 25 per cent.

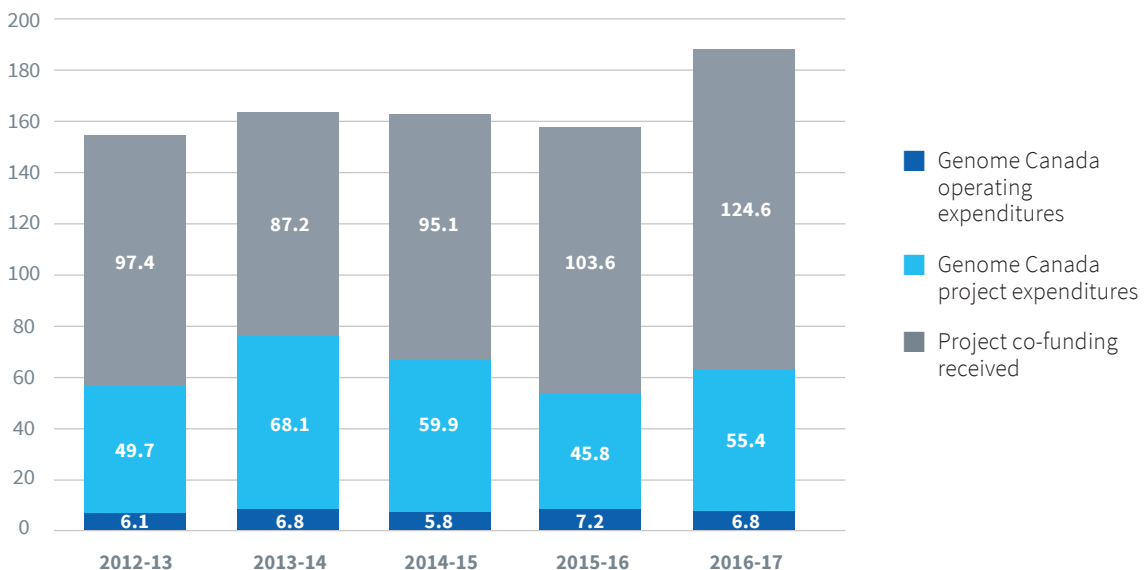
For positions that exceeded \$100,000 in the year ended March 31, 2017, the following are the annual salary ranges:

- president and CEO      \$275,000 to \$340,000
- vice-presidents        \$133,659 to \$200,489
- directors                \$100,000 to \$155,799

As of March 31, 2017, Genome Canada has \$48 million in investments, at market value. These investments are administered in accordance with the board of directors’ approved investment policy and in accordance with the terms and conditions of the contribution agreement with the federal government. The investment policy remained unchanged this past fiscal year.

**Figure 3**

**ANNUAL ACTIVITY**  
(in millions of dollars)





# AUDITOR'S REPORT

Financial statements of

# **Genome Canada**

March 31, 2017

# Genome Canada

March 31, 2017

## Table of contents

Independent Auditor’s Report ..... 1

Statement of financial position ..... 2

Statement of operations and changes in net assets ..... 3

Statement of cash flows ..... 4

Notes to the financial statements ..... 5-9

## Independent Auditor's Report

To the Directors of  
Genome Canada

We have audited the accompanying financial statements of Genome Canada, which comprise the statement of financial position as at March 31, 2017, and the statements of operations and changes in net assets and of cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

### Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these 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.

### Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements 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. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

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

### Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of Genome Canada as at March 31, 2017, and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.



Chartered Professional Accountants  
Licensed Public Accountants

June 15, 2017

# Genome Canada


## Statement of financial position


as at March 31, 2017

(in thousands of dollars)

	2017	2016
	\$	\$
<b>Assets</b>		
Current assets		
Cash and cash equivalents (Note 3)	21,637	32,736
Interest receivable	125	83
Other receivables	93	135
Prepaid expenses	154	158
	<b>22,009</b>	<b>33,112</b>
Investments (Note 4)	27,808	11,863
Capital assets (Note 5)	100	118
	<b>49,917</b>	<b>45,093</b>
<b>Liabilities</b>		
Current liabilities		
Accounts payable and accrued liabilities	707	908
Deferred contributions (Note 6)	49,110	44,067
Deferred contributions related to capital assets (Note 7)	100	118
	<b>49,917</b>	<b>45,093</b>
Commitments and contingencies (Notes 9 and 10)		
<b>Net assets</b>	-	-
	<b>49,917</b>	<b>45,093</b>

On behalf of the Board

  
\_\_\_\_\_  
Director

  
\_\_\_\_\_  
Director

# Genome Canada

## Statement of operations and changes in net assets year ended March 31, 2017

(in thousands of dollars)

	2017	2016
	\$	\$
<b>Revenues</b>		
Amortization of deferred contributions (Note 6)	62,162	53,039
Amortization of deferred contributions related to capital assets (Note 7)	53	50
	<b>62,215</b>	<b>53,089</b>
<b>Expenses</b>		
Projects and Genome Centres	55,419	45,850
Program management	2,001	2,177
Strategy, Development and External Relations	2,444	2,273
Corporate Services	2,298	2,739
Amortization of capital assets	53	50
	<b>62,215</b>	<b>53,089</b>
<b>Excess of revenues over expenses, being net assets, end of year</b>	<b>-</b>	<b>-</b>

# Genome Canada

## Statement of cash flows

### year ended March 31, 2017

(in thousands of dollars)

	2017	2016
	\$	\$
Net inflow (outflow) of cash and cash equivalents related to the following activities:		
<b>Operating</b>		
Excess of revenues over expenses	-	-
Items not affecting cash		
Amortization of capital assets	53	50
Change in fair value of investments	58	52
Amortization of deferred contributions (Note 6)	(62,162)	(53,039)
Amortization of deferred contributions related to capital assets (Note 7)	(53)	(50)
Excluded from the increase in deferred contributions (Note 8)	(177)	(48)
	<b>(62,281)</b>	<b>(53,035)</b>
Interest received on investments	509	274
Portfolio investment management	(69)	(59)
Grants received from Government of Canada (Note 6)	66,900	67,400
Deferred contributions related to capital assets	35	9
Change in operating assets and liabilities:		
Decrease (increase) in other receivable	42	(23)
Decrease in prepaid expenses	4	7
(Decrease) increase in accounts payable and accrued liabilities	(201)	274
	<b>4,939</b>	<b>14,847</b>
<b>Investing</b>		
Purchase of investments	(45,970)	(36,898)
Proceeds on disposal of investments	29,967	27,981
Purchase of capital assets	(35)	(9)
	<b>(16,038)</b>	<b>(8,926)</b>
Net cash and cash equivalent (outflow) inflow	<b>(11,099)</b>	5,921
Cash and cash equivalents, beginning of year	<b>32,736</b>	26,815
<b>Cash and cash equivalents, end of year</b>	<b>21,637</b>	<b>32,736</b>



# Genome Canada

## Notes to the financial statements

March 31, 2017

(in thousands of dollars)

---

### 1. Description of the business

Genome Canada (the "Corporation") was incorporated on February 8, 2000 under the Canada Corporations Act and continued on December 11, 2012. The Corporation is a not-for-profit organization and has the following objectives:

- a) The development and establishment of a co-ordinated strategy for genomics research to enable Canada to become a world leader in areas such as health, agriculture, environment, forestry, fisheries, mining and energy;
- b) The provision of leading-edge technology to researchers in all genomics-related fields through regional Genome Centres across Canada, of which there are currently six, one each in British Columbia, Alberta, the Prairies, Ontario, Quebec and the Atlantic;
- c) The support of large-scale projects of strategic importance to Canada by bringing together industry, government, universities, research hospitals and the public;
- d) The assumption of leadership in the area of ethical, environmental, economic, legal, social and other issues related to genomics research, and the communication of the relative risks, rewards and successes of genomics to the Canadian public; and
- e) The encouragement of investment by others in the field of genomics research.

### 2. Significant accounting policies

The financial statements have been prepared in accordance with Canadian accounting standards for not-for-profit organizations and include the following significant accounting policies:

#### *Revenue recognition*

The Corporation follows the deferral method of accounting for contributions received from the Government of Canada.

Externally restricted contributions and related investment income are recognized as revenue in the year in which the underlying expenses are incurred. A receivable is recognized if the amount to be received can be reasonably estimated and collection is reasonably assured.

Externally restricted contributions for purchase of capital assets are deferred and amortized to revenues on a declining-balance basis at a rate corresponding to the amortization rate for the related capital assets.

#### *Cash and cash equivalents*

Cash and cash equivalents consist of cash as well as highly liquid short-term investments. The Corporation considers highly liquid short-term investments as those having a maturity of less than three months from the date of acquisition. Cash and cash equivalents are recorded at fair value.

#### *Investments*

Investments are recorded at fair value. Fair value is determined at quoted market prices. Sales and purchases of investments are recorded at the settlement date. Transaction costs related to the acquisition of investments are expensed.

#### *Financial instruments*

The Corporation records interest and other receivable and accounts payable and accrued liabilities at amortized cost using the effective interest method of amortization.

# Genome Canada

## Notes to the financial statements

March 31, 2017

(in thousands of dollars)

### 2. Significant accounting policies (continued)

#### Capital assets

Capital assets are stated at their net book value. Amortization is provided for using the declining-balance method at the following annual rates and term:

Furniture and fixtures and office equipment	20%
Computers and software	50%
Telecommunication equipment	30%
Leasehold improvements	Term of lease

#### Pension plan

The Corporation maintains, for the benefit of almost all of its employees, a defined contribution pension plan. The cost of the plan is recorded in the statement of operations as it is incurred. The charge for the year totals \$216 (2016 - \$208).

#### Use of estimates

The preparation of financial statements in conformity with Canadian accounting standards for not-for-profit organizations requires the use of estimates and assumptions that affect the reported amounts of assets and liabilities, disclosures of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting periods. Accordingly, actual results could differ from these estimates. The most significant estimates used in the preparation of the financial statements include the fair value of investments, the amount of certain accrued liabilities and the estimated useful lives of capital assets. These estimates are reviewed annually and as adjustments become necessary, they are recorded in the financial statements in the year in which they become known.

### 3. Cash and cash equivalents

	2017	2016
	\$	\$
Cash	986	711
Short-term investments	20,651	32,025
	<b>21,637</b>	<b>32,736</b>

### 4. Investments

	2017		2016	
	Fair value	Cost	Fair value	Cost
	\$	\$	\$	\$
Federal government bonds	8,030	8,048	4,662	4,667
Provincial government bonds	12,745	12,818	3,010	3,022
Corporate bonds	7,033	7,049	4,191	4,223
	<b>27,808</b>	<b>27,915</b>	<b>11,863</b>	<b>11,912</b>

The interest rates at the end of the year range from 0.987% to 6.145% (2016 - 0.98% to 5.28%) and mature at varying dates in 2017 and 2018 (2016 - varying dates in 2017).

# Genome Canada

## Notes to the financial statements

March 31, 2017

(in thousands of dollars)

### 5. Capital assets

			2017	2016
	Cost	Accumulated amortization	Net book value	Net book value
	\$	\$	\$	\$
Furniture, fixtures and office equipment	224	176	48	20
Computer and software	177	177	-	1
Leasehold improvements	152	100	52	97
	<b>553</b>	<b>453</b>	<b>100</b>	<b>118</b>

Cost and accumulated amortization at March 31, 2016 amounted to \$549 and \$431, respectively.

### 6. Deferred contributions

The Corporation receives contributions from the Government of Canada to be held, invested, administered and disbursed in accordance with the related funding agreement between Genome Canada and the Government of Canada.

The Corporation currently operates under four active funding agreements with Innovation, Science and Economic Development Canada. The terms and conditions of these agreements call for payments to be made to the Corporation annually, subject to the appropriation by Parliament, at the beginning of each fiscal year, based on the estimated cash requirements for the coming year. During the year ended March 31, 2017, the Corporation received \$4,500 under the agreement dated March 31, 2008, \$7,900 under the agreement dated January 3, 2012, \$5,000 under the agreement dated January 25, 2013, and \$49,500 under the agreement dated March 10, 2014.

The changes in the deferred contributions balance for the year are as follows:

	2017	2016
	\$	\$
Balance, beginning of year	44,067	29,457
Add: grants received	66,900	67,400
Add: investment income	340	258
Less: amounts amortized to revenue	(62,162)	(53,039)
Less: amounts invested in capital assets	(35)	(9)
Balance, end of year	<b>49,110</b>	<b>44,067</b>

#### *Expenses of future years*

Deferred contributions related to expenses of future years represent unspent externally restricted funding received to date, together with investment revenue earned, for the purpose of providing funds to eligible recipients and paying for operating and capital expenditures in future years.

# Genome Canada

## Notes to the financial statements

March 31, 2017

(in thousands of dollars)

### 7. Deferred contributions related to capital assets

Deferred contributions related to capital assets represent restricted contributions with which capital assets were originally purchased.

The changes in the deferred contributions balance for the year are as follows:

	2017	2016
	\$	\$
Balance, beginning of year	118	159
Add: acquisition of capital assets	35	9
Less: amounts amortized to revenue	(53)	(50)
Balance, end of year	100	118

### 8. Supplemental cash flow information

	2017	2016
	\$	\$
Gain (loss) on disposal of investments	(81)	42
Amount transferred to capital assets	(35)	(9)
Fair value adjustment	(61)	(81)
	(177)	(48)

### 9. Commitments

#### *Committed funding*

The Corporation is committed to finance approved research projects, science and technology platforms and Genome Centre operations in accordance with established agreements. As at March 31, 2017, the payments committed are approximately \$47,987 in 2018 and \$60,942 for other future years.

#### *Operating leases*

The Corporation leases its premises and equipment under long-term operating leases, which expire at various dates between 2018 and 2021. The minimum aggregate lease payments are approximately as follows:

	\$
2018	154
2019	34
2020	9
2021	4

# Genome Canada

## Notes to the financial statements

March 31, 2017

(in thousands of dollars)

---

### 10. Contingencies

In the normal course of business, the Corporation has entered into a lease agreement for premises. It is common in such commercial lease transactions for the Corporation as the lessee, to agree to indemnify the lessor for liabilities that may arise from the use of the leased assets. The maximum amount potentially payable under the foregoing indemnities cannot be reasonably estimated. The Corporation has liability insurance that relates to the indemnifications described above.

### 11. Fair value of financial instruments

The carrying value of interest receivable, other receivables, and accounts payable and accrued liabilities approximates their fair value because of the relatively short period to maturity of the instruments.

The fair value of investments is disclosed in Note 4 to the financial statements.

The Corporation is not subject to significant currency risk arising from its financial instruments. The Corporation is exposed to credit and interest rate risk with respect to its interest-bearing investments. The Corporation invests in government bonds to reduce the credit risk to an acceptable level.

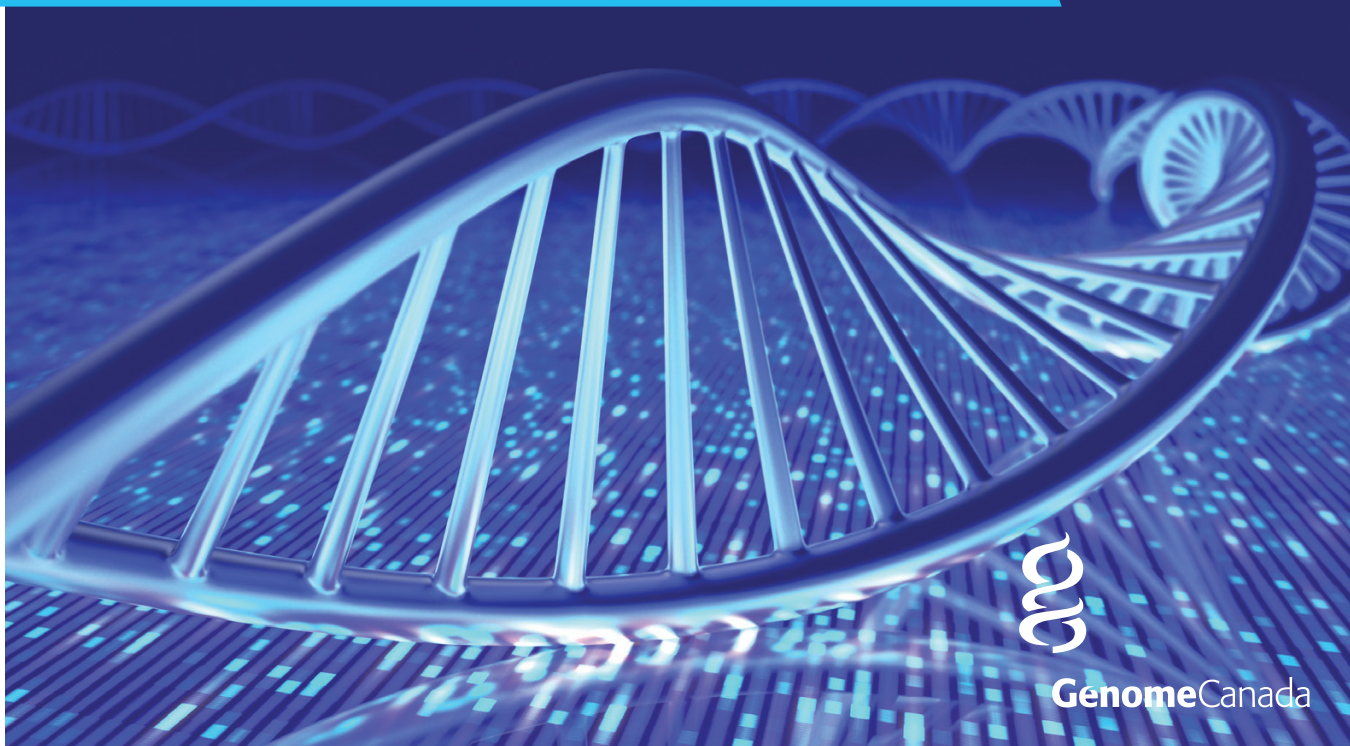
### 12. Comparative figures

Certain comparative figures have been reclassified to conform with the current year's presentation.



# ACKNOWLEDGEMENT

We wish to thank the Government of Canada for its leadership in genomics and continued support of Genome Canada.



GenomeCanada





**Genome**Canada

150 Metcalfe Street, Suite 2100  
Ottawa, ON K2P 1P1

[www.genomecanada.ca](http://www.genomecanada.ca)