

PART-2 INSTITUTIONAL STRATEGY**a) The Status of the CFREF Governance Structure and Leadership**

a.1 The current governance structure: GWF is the largest freshwater research program in the world and is governed by four partner universities, led by USask. Its governance and management structure implements this partnership and supports the program. The governance structure builds on decades of experience leading large research networks and represents a lean matrix structure reflecting the trans-Canadian breadth of this network as well as the importance of transdisciplinary collaboration and mobilization of solutions to end-users (see *Figure E.1 in Appendix E*). The governance and management of GWF involves the Principal Investigator (USask VPR) who chairs the Oversight Committee; the GWF Director and Associate Director, who form the Directorate and chair the Strategic Management Committee; the Executive Director of the Global Institute for Water Security (GIWS) who has financial responsibility for the funds, administers Secretariat staff and liaises with the Principal Investigator and Directorate; several advisory groups: an International Advisory Panel, Indigenous Advisory Panel, and User Advisory Panel, and a Strategic Advisor; an Operations Team composed of the leads of the 45 projects and core teams; a Young Professionals Executive that acts as a liaison with SMC and organizes social and professional development activities; and, the GWF Secretariat, comprised of administrative, financial, communications, and outreach personnel (see *Appendix E for lists of personnel*). The governance and management structure for GWF was created to achieve the mission and vision of the GWF through its three Pillars (1-Transformative Science, 2-Big Data and Decision Support Tools, and 3-User Question-led Transdisciplinary Science), whilst directed towards the CFREF criteria of global research excellence and leadership, and transdisciplinary research of economic benefit to Canada. In addition, the transdisciplinary structure ensures breaking down disciplinary and institutional barriers to ensure a holistic approach to what are inevitably multidimensional water problems that have solutions with a degree of predictive uncertainty. In addition to achieving the mission to improve disaster warning, predict water futures, and inform adaptation to change and risk management, GWF aims to be known for engagement of Indigenous communities in co-developing water research as well as a leader in equity, diversity, and inclusion in water research and networks. The GWF Young Professionals (GWF-YP) strategy was created and implemented to provide additional training to assist career development and professional advancement as well as to provide networking opportunities.

The governance and management structure consists of three decision-making levels; governance, strategic management and operational management, supported by the Secretariat. The governance body is the **Oversight Committee (OC)**, which consists of the Vice-President Research from the four partner institutions (USask; UWaterloo; McMaster; Wilfrid Laurier). The OC is supported by the GIWS Executive Director and the GWF Director who report to this committee. The OC meets on a quarterly basis and ensures that the vision, mission, and objectives are achieved, monitors progress, holds the program to the highest standards of research and training excellence, and promotes broad engagement across the partner universities as well as other national and international partners and key stakeholders.

The management body is the **Strategic Management Committee (SMC)**, which manages the program, provides scientific and financial direction, and ensures delivery of transformational science. Budget allocation amongst partner institutions and investigators has been achieved through strategic proposal calls by the SMC and international peer review evaluations of received proposals, organised by the Secretariat to inform SMC funding decisions. Distinguished scientists from academia and government serve on the committee, which meets monthly.

The operating body is the **Operations Team (OT)**, consisting of the leads and program managers from [12 Pillar 3 user question-led projects](#), [21 Pillar 1 and 2 transformative science, decision support and big data projects](#), [6 Pillar-3 Indigenous Community co-led water research projects](#), and 6 core support teams (Modelling and Forecasting, Knowledge Mobilization, Computer Science, Communications, Data Management, Technicians) that implement transformative and transdisciplinary science research and

development to achieve the overarching goals of GWF. The OT meets twice yearly – one of which immediately precedes the Annual Open Science Meeting.

The Directorate and SMC are supported by the *International Science Advisory Panel (ISAP)*, the *Indigenous Advisory Panel (IAP)*, and the *User Advisory Panel (UAP)*. The ISAP is composed of internationally recognized scientists and research leaders who offers guidance on strategic program direction to ensure delivery of transformational science that addresses the needs of Canada and the world. The ISAP meets once a year; however, the SMC seeks their expertise and input as needed to review proposals. The IAP is composed of Indigenous thought leaders from across Canada who review proposals for and advise the SMC, and contribute to the UAP. The UAP is a high-level, strategic cross-sectoral committee, which ensures GWF delivers risk management solutions aligned with federal strategies and provincial, industrial, and community needs, including Indigenous needs of benefit to Canada. This committee has recently been formalized and now meets on a quarterly basis, jointly with the IAP.

The Canada Excellence Research Chair Laureate in Water Security and former Program Director for GWF is the *Strategic Advisor to the SMC* for the overall program.

The GWF *Secretariat* supports the Directorate, SMC, and OT, and assumes responsibility for day-to-day operation of the GWF network, overseeing and coordinating operational support leads and teams including HR, Finance, Communications and Marketing, Stakeholder Outreach & Engagement, Commercialization & IP, Data Management & Training functions.

The *YP Executive* consists of four Chapter Chairs (one each for USask, UWaterloo, McMaster, and Wilfrid Laurier) who are supported and advised by the GWF Outreach Coordinator. Each Chapter Chair is appointed for a one-year term and is eligible for renewal or re-election. One of the Chapter Chairs is chosen as the President, and all chairs can appoint co-chairs to reduce workload. The position of President is rotated annually amongst the universities. In addition, the President of the Canadian Young Hydrologic Society (CYHS) is the 5th Executive member.

a.2 Governance activities carried out to date: The first steps in developing GWF involved nation-wide user engagement and the establishment of Core Teams. By engaging with the user community across Canada in a series of discussions of water problems and needed solutions, conducting a review of water research needs based on these discussions, and finally developing a report on the key user needs and questions that the GWF program might address, GWF identified the user questions for the transdisciplinary Pillar 3 User-Question led Projects and set priorities for supportive science and technology in Pillars 1 and 2 (Transformative Science, Big Data, and Decision Support Tools). During this process, it was realized that there was a need to hold additional consultations with Indigenous communities to co-develop a process to create co-led Indigenous community water research projects. The Core Teams and their strategic activity plans were developed early on to include modelling and forecasting, technical, data management, computer science, knowledge mobilization, and communications teams, which provide central capabilities and functions for Pillar 2 and support for the whole GWF.

Governance and management meetings of the three layers have been ongoing as per schedules outlined in *a.1*. Semi-annual OT meetings were instituted in winter 2017-18 to bring together the GWF project principal investigators, project managers, core team leads, SMC, OC, YP, Secretariat, and Knowledge Mobilization, Data Management, and Communications core team staff—together to review project and core team progress, discuss GWF science directions and operations, and to plan special initiatives. These are held at different institutions and locations across Canada. [[2018 OT Meeting](#); [2019 OT Meeting](#)]

Annual Open Science Meetings started for GWF in spring 2018, and include a dedicated day for an OT meeting in parallel with a GWF-YP career and professional development day focused on activities such as workshops on enhancing written and oral communication skills, “The Art of Scientific Investigation,” providing advice on navigating graduate school and career paths, attributes of successful scientists, and tips on communicating research outcomes. A significant part of the open science meetings have been dedicated towards exchanges with Indigenous communities on Indigenous governed lands,

including sharing traditional ecological knowledge and Indigenous approaches, and learning about Indigenous water issues, and Indigenous ways of understanding water. The remainder has focussed on a number of exciting, informative, and unique events and activities designed to demonstrate, review and synthesise GWF's technical and scientific advancements, whilst promoting further development and training of early career researchers, integration of science research, Indigenization and decolonization of GWF in the spirit of reconciliation, and engaging with partners and stakeholders [[2018 Annual Meeting](#); [2019 Annual Meeting](#)]. The inaugural 2018 GWF open science meeting is believed to be the first national science meeting held on First Nation administered territory at Ohsweken, Six Nations of the Grand River.

GWF applied to CFREF with a proposal budget of \$149 million. When the program began, the actual GWF budget was found to be \$143 million, comprised of the \$77.84 million CFREF grant and \$65.22 million support from the four partner institutions. Further, while partner funds are to be used for the benefit for the program, they are not allocable by the SMC. Hence, the budget available for allocation by SMC is \$77.84 million. The SMC agreed not to automatically allocate resources to the four partner universities, but to award funds competitively, based upon merit and program needs. A four-tier funding model was adopted to develop a suite of GWF research projects:

- Seed funding for workshops to identify and advance disciplinary research needs and opportunities;
- Funding for core GWF teams in support of Pillar 2 and the overall program;
- Funds to co-develop an Indigenous community water research strategy and then issue an open call for proposals to develop Indigenous community co-led projects;
- Funds allocated under an open call for proposals to develop transdisciplinary user-question led projects in alignment with GWF deliverables under Pillar 3 (Transdisciplinary Science); and,
- Funds allocated under an open call for proposals to identify new opportunities and accelerate research development under Pillars 1 (Transformative Science) and 2 (Big Data & Decision Support Tools).

Figure 2.1 shows the budget allocation and breakdown. The largest set of funds were allocated for trans-disciplinary user-question led science (Pillar 3) and core functions of technical support for observations and modelling/ forecasting. Supporting these main activities were substantive allocations to transformative science (Pillar 1), big data (Pillar 2), and the 6 core teams. Supporting the whole program is the Secretariat with program, science, and operational management, as well as finance, communications, and outreach functions.

GWF Core Teams: GWF core teams were designed to provide the necessary underpinning for core program objectives and deliverables, specifically:

- National capability for the modelling needed to deliver key programme goals;
- Capability for field and laboratory observations to support science, in particular with respect to key water observatories; and
- Support for delivering research that is driven by user-led needs and solutions.

Activity	Budget
GWF Secretariat including communications	\$5.7 million
<i>Core CFREF activities (directed funding):</i>	
Data Management, Computing, Knowledge Mobilization teams	\$6.9 million
Technical support (field/lab technicians, research staff, travel)	\$13.4 million
Modelling/forecasting (hydrology/land surface systems; water resources; water quality) (including \$1.5 million for Planetary Water Prediction Initiative)	\$11.9 million
Pillars 1 & 2 – Transformative science/big data - (competitive funding)	\$9.2 million
Pillar 3 - Indigenous Community Water Research Projects – (competitive funding)	\$1.6 million
Pillar 3 – User-question led projects - (competitive funding)	\$26.2 million
Network meetings	\$2.9 million
Total	\$77.84 million

Figure 2.1: GWF Budget Breakdown

A budget of \$14.6 million has been allocated over 2017-2020 to support core team activities.

The **Modelling and Forecasting Team** was provided with \$11.9 million to deliver the “new modeling tools” and disaster warning systems for Canada and the cold regions of the world that were identified as key program deliverables. This team strategically links to and supports GWF Projects with its capabilities and model products. The projects also supplement modelling resources and provide topical and sectoral innovation for new models. This team is headquartered in the *Canadian Centre for Water Forecasting and Prediction* building (USask) to provide a critical mass of modelling capability and expertise to accomplish GWF’s prediction goals. Other important clusters of activity are at UWaterloo (significant focus on water quality modelling) and the USask Coldwater Laboratory in Canmore, AB. The team also operates the **Planetary Freshwater Prediction Initiative**, which, with \$1.5 million in funding, advances the computational infrastructure (datasets, modeling capabilities) necessary to produce continental and global-domain simulations and predictions of hydrological risks with an emphasis on river basins where high mountain water supplies feed local and downstream water demands and ecosystem needs.

The core public and sectoral engagement, information stewardship, data, and numerical analysis functions of GWF were allocated \$6.9 million. Three teams were developed to deliver on these functions:

The **Knowledge Mobilization (KM) Team** provides oversight, advice, and direct support for KM initiatives of GWF-funded projects. KM specialists focus on assisting project investigators, researchers and staff to succeed in their stated KM goals whilst also identifying and creating opportunities to facilitate and develop KM capacity across the GWF network. All projects that have been granted more than \$500K are required to develop and maintain their own website to showcase their activities and outcomes to partners (collaborators, users, and stakeholders) and society. The primary mandate of KM specialists is to support GWF Pillar 3 transdisciplinary projects, but their goal is also to create resources that can be shared through the broader network, therefore supporting Pillar 1 and 2 and central initiatives.

The **Data Management Team** promotes and governs the management, retention, use, and dissemination of data collected as part of the GWF program’s research activities. It maintains relationships with core teams and projects to ensure environmental, social, and health data outputs are archived according to Tri-council objectives and, where appropriate, readily usable by the whole GWF program.

The **Computer Science Team** meets the demands of advanced water modelling and visualization of large data by providing new science to support software improvement, human-computer interaction, and data management. It also provides a consistent computing platform to support integration and to take advantage of common, scalable functionality for all GWF models and tools.

GWF allocated \$13.4 million for core technical support of its field and laboratory facilities, which when clustered are referred to as water observatories, and established the **Technical Team** to provide strategic support to 60 water research observatories and major research facilities across Canada. The technicians maintain and often lead field and lab studies in aid of HQP training, often in remote sites and under inclement weather conditions. To support this team, GWF remote field bases were established (Whitehorse, YT; Yellowknife, NWT) and refurbished (Coldwater Laboratory, Canmore, AB).

To advance the strategic directions of GWF locally, nationally, and internationally, the **Communications Team**, funded through the Secretariat and partner institutions, addresses and implements strategies for building awareness and sharing findings with the public and key audiences. It is also responsible for evaluating activities and measuring the success of the communications plan.

GWF places significant emphasis on professional development and training of early career researchers, who are considered key legacies of the program. GWF has created national and international capacity to provide the expertise needed for Canada and the world to sustainably manage water futures. GWF has initiated unique training opportunities such as the [Distinguished Lecture Series](#), the [Women and Water Lecture Series](#), the [Knowledge Mobilization Webinars](#), and offered more than 159 Special Courses, and Cross Institution Training, 249 Seminars and workshops, and 76 early career training opportunity (see *Part-5 PMP Progress Report and Appendix C* for details). GWF works closely with the USask-

UWaterloo-McMasterU-UCalgary [NSERC Create in Water Security](#) to support HQP training, exchanges, and industry engagement. For details, refer to *section b* of the *Part-1 Science Strategy report*.

a.3 How CFREF funding is allocated to researchers and how the governance structure supports this approach? GWF envisioned a series of competitively funded transdisciplinary, scientifically transformative, and strategic *projects* supporting each of its pillars and helping to meet GWF objectives. For all projects excellent science, inter-institutional collaboration, geographical representation, strong financial, data, and operational management, and a strong record of accomplishment were important selection criteria. Consideration of equity, diversity, and inclusivity was highly encouraged, as was user engagement (mandatory for Pillar 3 projects).

The SMC envisioned funding several large consortium-based transdisciplinary projects to answer user needs from a regional, sectoral, or topical perspective. These **Pillar 3 projects** were allocated \$26.3 million over seven years. A formal two stage request for proposals was initiated in November 2016, informed by an internal user needs report. The call was open to 388 faculty, comprising water researchers from the four partner universities and individual researchers (representing an additional 14 Canadian universities) listed in the original proposal (*see Appendix F for Call for proposals*). GWF developed a rigorous international peer-review evaluation process and engaged the advice of the ISAP to guide final decisions by the SMC overseen by the OC. Thirty-three Letters of Intent (LOI) were each reviewed by three international reviewers and then evaluated by the ISAP who provided the SMC with independent advice and recommendations. The SMC accepted the ISAP's recommendations and consequently 14 LOIs were invited to submit full proposals, which were then reviewed by the SMC. Given the high quality of the proposals, GWF funded [12 projects](#) with a total budget of almost \$16.9 million between 2017 and 2020. In October 2019, 11 Pillar 3 projects accepted an invitation to submit renewal proposals for 2020-2023 (the remaining proposal sought a 1-year no-cost extension). The total budget requested was more than \$13.8 million, of which \$9.34 million was awarded by the SMC after international peer review and consultation with the ISAP. In total, Pillar 3 projects have funded 117 faculty from 15 Canadian universities, in collaboration with 327 partners, collaborators and users. The \$25.74 million investment in Pillar 3 projects leveraged another \$2.8 million in cash from universities and partners, as well as \$22 million in in-kind contributions from partners.

A 7-year, \$9.2 million science budget was created to fund **Pillar 1 and 2 projects**. To select projects, proposals were requested and reviewed using the same competitive process as Pillar 3. Fourteen substantive projects were funded, with a budget of \$5.8 million. An additional 7 smaller pilot and studentship projects were funded for a total of [21 projects](#) and \$6.6 million. These projects have funded 94 faculty from 10 Canadian universities, in collaboration with 37 partners from international institutions, government agencies, industry partners, non-governmental organizations, and Indigenous communities. The projects have leveraged the GWF investment of \$6.6 million with an additional \$1.6m in cash and \$1.5m of in-kind contribution from partners. A second call for proposals for new Pillar 1 and 2 projects was launched in 2020 with a budget of \$2.5 million; reviews and funding decisions were completed in the summer of 2020 with an anticipated 12 new projects for 2020-2023.

The development of the call for **Indigenous co-led Pillar 3 projects** deserves special attention. GWF reached out to numerous Indigenous academics, communities and thought-leaders for advice on water research that GWF and Indigenous communities could best conduct together to help address the severe water crisis experienced by Indigenous communities in Canada. Out of these consultations, GWF funded 6 projects (three Pillar 1 and 2, and three Pillar 3 projects) that engage substantially with Indigenous communities and organisations, but this was not felt to be a sufficient response to the research needs and desire for more fulsome co-development that were identified. Consequently, a workshop was organized at a 6000-year-old Indigenous ceremonial and living site - the First Nations-operated Wanuskewin Heritage Park near Saskatoon, SK - on April 17/18, 2018. The workshop involved 62 attendees, including 31 Indigenous community representatives, to promote further discussion and action on these research

ideas through development of Indigenous community–university partnership projects that both met Indigenous community needs and were in alignment with the GWF vision/mission.

The workshop was highly interactive with the discussions and working sessions focussed on building on existing relationships, identifying new potential partnerships, identifying common research themes and community needs, co-designing proposal elements and evaluation criteria, and identifying leveraging opportunities with funding partners. The workshop started and concluded on very positive notes with a commitment to co-develop and evolve GWF’s Strategy for Indigenous Community Water Research. It was agreed that this was a great beginning to new relationships and a new way of engagement between academic research and Indigenous communities that could be the foundation for the much needed partnerships, knowledge, and capacity to address the water and climate issues affecting Indigenous communities across Canada. The primary outcome of the workshop was the development of the request for proposals for expressions of interest. Subsequently, in December 2018, after review by and in consultation with the IAP, the SMC funded [6 projects](#) that are co-led by Indigenous community leaders and university investigators for a total of \$1.63 million over 3 years (2019-2022). These new Pillar 3 projects are felt to be exemplars of co-led Indigenous community water research in Canada, in that they that resulted from a focussed, innovative, co-designed request for proposal process and a review process that featured peer review by Indigenous water experts.

GWF aims to be an inclusive program of water researchers in Canada and those globally that can contribute towards the vision and mission of the GWF. Many research opportunities have arisen and have been pursued by eligible GWF members and others interested in the program, but were not included in GWF-funded projects. However, these initiatives contribute strategically towards the GWF vision and mission and so it is possible for GWF to provide in-kind support to these projects and to benefit from such linkages to expand its research envelope. The purpose of the ***GWF Affiliated Projects*** is to find ways to align with and link to projects that are outside of the direct funding remit of GWF, to benefit both the Affiliated Projects and GWF. The SMC reviews these projects based on alignment with GWF goals and objectives, scientific excellence, open data and open source modelling, and has approved 7 Affiliated Projects based in Canada, USA, and New Zealand.

b) Schedule of Activities with Milestones (achieved and planned)

The activities and milestones in this section are compared to what was originally proposed in the 2016 *Institutional Strategy* under the title of “Scope of Work and Key Activities” (*also see Appendix E for detailed chart on milestones and their progress*). It is important to note that GWF has made significant strides in generating science to inform policy decisions; for example, it is currently informing the establishment of the Canada Water Agency, informing on how Canada can meet its UN Sustainable Development Goals, and how a national flood and streamflow forecasting system can be developed (refer to *Part-1 Scientific Strategy report* for details).

b.1 Year 1 – Mobilizing the GWF Program (*see Appendix E for detailed milestones*)

Operational: Of the eight original milestones, seven were achieved. One, the activity on “IP and Commercialization Plans” was adjusted after consultations with users and ISAP made it clear that GWF software products should be distributed with open source licensing and that technical and scientific advances should be publically presented, published, and distributed openly to users with an open use license. This open activity is detrimental to patent approval but we are advised that it is highly effective in generating economic activity from users. The IP and Commercialization Plan milestone was therefore adjusted to include the open source alternative. It should be noted that patents are still permitted in GWF and some are expected later in the program.

Scientific: All six milestones have been achieved. The program is well underway as project teams, with transdisciplinary representation and international partnerships, use directed funding to launch projects across pillars. The Knowledge Mobilization core team is working closely with all funded projects to ensure engagement of stakeholders who continue to shape our direction.

b.2 Year 2 – Building Momentum for the Program (see Appendix E for detailed milestones)

Operational: The activities of issuing requests for proposals, initiating projects, HQP recruitment and integration, and project progress tracking are ongoing. However, all were successfully initiated.

Scientific: All scientific milestones were achieved, including the establishment of fully instrumented water research observatories; remote data streaming; inception of transdisciplinary projects (involving national and international collaborators and partners/users/stakeholders); and, recruitment of HQP to research projects. In the original proposal, GWF committed to hiring 20 new faculty members (8 USask, 5 UWaterloo, 5 WLU, and 3 MU) to expand Canada’s research capacity in identified research gaps or areas that need further bolstering. Consequently, 16 faculty members have been hired (7 USask, 4 UWaterloo, 3 WLU, and 2 MU) and searches for the remaining are underway. The delay is primarily due to GWF being unable to find the right person for some identified positions. Details of hired faculty members are provided in the *Part-5 Performance Measurement Plan*.

b.3 Years 3-5 – Realizing Impact from the Program (see Appendix E for detailed milestones)

Operational: GWF’s leadership strengthened the program by making adjustments in strategic direction with advice from the ISAP, especially during the project proposal review process. Accelerating the vision that GWF should provide water solutions to the world, GWF held an international symposium in 2017 to identify societally-relevant grand water challenges, and inform an international strategy for the program. The symposium reflected on developments in hydrology, water science, engineering, and practice over the last 40 years, and projections of future directions for the next 40 years. Thirty-five leading international scientists shared their vision and provided valuable feedback to inform the GWF international agenda. All of the stated milestones were achieved and the ***Planetary Water Prediction Initiative*** resulted from this consultation. GWF signed MOUs with NRCan, the Indian Institute of Science, and the [Chinese Academy of Sciences](#) for scientific collaboration and, with NRCan, co-hosted a national meeting of federal and GWF water scientists in Ottawa to develop collaborations. GWF strengthened its relationship with Environment and Climate Change Canada (ECCC) by co-hosting the first [National Streamflow Forecasting Workshop](#) with all 13 provinces and territories and federal government agencies. This meeting initiated discussions on what a national streamflow forecasting system could be and what support GWF could provide for its development. GWF also instituted an [Artist-in-Residence](#) to better engage users and interpret science. This has resulted in hundreds of paintings displayed in GWF-themed exhibitions in galleries in England, Alberta, Belarus and Ontario and used in GWF presentations. In order to analyze Canada's emerging water crisis and to chart a path forward to ensure water security for all Canadians, [Water Security for Canadians](#) is a partnership between GWF and the Forum for Leadership on Water, Centre for Indigenous Environmental Resources, University of Victoria Centre for Global Studies, Beaubien Foundation, Massey College, and UN University Institute for Water, Environment and Health. Activities include promoting the concept of a Canada Water Agency as well as calls for renewed federal water policy and updated Canada Water Act. Further to these activities and advice, the federal government mandated the establishment of the Canada Water Agency to the Minister of ECCC in autumn 2019.

Scientific: As promised, GWF informed the establishment, through international partners, of enhanced observing and prediction systems in strategic cold regions around the world (primarily through its leadership with the World Climate Research Programme (WCRP), [UNESCO – International Hydrological Programme](#), World Meteorological Organisation (WMO), and Future Earth). GWF was approved as a [Regional Hydroclimate Project](#) (one of three globally and the only in North America) by the Global Energy and Water Exchanges (GEWEX) of WCRP in 2018 and hosted the GEWEX global meeting in Canada for the first time. GWF leads WCRP’s [International Network for Alpine Research Catchment Hydrology](#) which implements integrated observing and prediction systems in mountain cold regions around the world. GWF chaired global meetings for [WMO](#) and [Future Earth](#) in Switzerland, Iceland, and India. The core modelling and forecasting team has made significant strides in modifying existing models and developing new models to improve forecasting and prediction systems (refer to *Part-1 Science*

Strategy for details). GWF is making data publicly available (e.g., [Data Portal](#), [Real-Time Graph Access](#), [Access to Data Software](#)) and implementing apps to support citizen science (e.g., [The Nutrient App](#)) which have exceptionally high uptake across Canada and co-development with ECCC.

b.4 Years 6-7 – Establishing Global Leadership (see Appendix E for detailed milestones)

Operational: Sustainability plans will be developed and implemented, including next generation approaches and tools. The Canada Water Agency was specifically mentioned by the Governor General in the September 2020 Speech from the Throne and so GWF expects to work with this new agency in developing national water science, data, observation, and modelling capabilities and capacities. We will conduct major reviews of activities, responding proactively as needed and share lessons learned and innovations in operations. Two key areas of focus will be creating space for Indigenous voices in water and demonstrating what EDI leadership can look like in a large research network.

Scientific: GWF has become the most cited water research grouping in the world. We will continue to enhance the sophistication of our models and continue to work with stakeholders to make them ‘user-friendly’. We will also synthesize knowledge across critical water-related themes, such as water quality, lakes, and cold regions hydrology to assess the state of science, methods, and knowledge. Solutions will be deployed on continental scales, expanding from our pilot programs using knowledge mobilisation strategies and commercialization routes where appropriate; our full suite of open source computer programs, data management systems, and apps will usher in a new era of public access to water information and citizen-engaged science. GWF will have made great advances in scientific knowledge, which will have been translated into user oriented solutions that warn of impending disasters, lead to more predictable water futures, and support decision-makers in optimally managing risk. With these tools, there will ultimately be greater decolonization of water management, more intelligent use of water, a measurable decline in associated negative social and economic impacts of water-related events, and improved environmental protection with better adaptation to the impacts of climate change.

c) The CFREF Budget Expenditures and the Leveraging Support

Table 10.1 in the appendix outlines the use of CFREF funds for the Scientific Strategy and *Table 10.2* outlines the use of CFREF funds for the Institutional Strategy. Consistent with the proposal, 100% of the CFREF funds are being used to support the Scientific Strategy. The Institutional Strategy is supported by the \$65.2 million contribution towards the program from the four partner institutions.

In addition to the details provided in Tables 10-12, *Figure 3.1* in *Part 3 – Budget report* summarizes the GWF budget, expenditures, and commitment for the CFREF funds used to support the projects, core teams, and administration as outlined in *Section a) – Governance Activities*, and the Lead and Partner Institutions leveraged funds.

d) Funding Secured from the Federal Tri-agencies and CFI.

Please refer to *Section 1b Part-1 Scientific Strategy Report* on how additional funding obtained from tri-agencies and CFI has furthered research capacity at partner institutions. Details on leveraged funding including tri-agencies are provide in *Tables 11.1 through 11.3*.

e) Implementation of the equity plan and progress toward meeting targets.

GWF is committed to recruitment/retention, career development, and recognition of members of equity-deserving categories. With USask and WLU as institutional members of the Dimensions Pilot Program (Canada), GWF is committed to integrating these principles into our policies, practices, action plans, and culture. GWF has equity role models in its senior leadership OC (woman PI & 3 out of 4 OC members are women), management leadership SMC (5 women out of 11 members, including one Indigenous scholar), and panels/projects, including professional and career development workshops, lecture series (Women in Water, Distinguished Lecturers), Indigenous community co-led projects, and Annual Science Meetings (see details in *Part-4 EDI report*). We are also implementing principles outlined in the NSERC “Guide for Applicants: Considering equity, diversity and inclusion in your application” and other Tricouncil documents. [[Website](#)]

Figure 2.2 shows 2018 equity, diversity and inclusion numbers for GWF as provided by the CFREF Secretariat. In comparison to other CFREF projects, a greater percentage of GWF members self-identify with equity-deserving groups, with the exception of persons with disabilities and Indigenous peoples. There is some uncertainty in these

	GWF	CFREF - 18 Projects
Number of participants contacted	618	5461
Number of surveys submitted	441	3404
Response rate	71%	62%
Women	179 (40.6%)	1134 (33.3%)
Indigenous peoples	*--	17 (0.5%)
Visible minorities	86 (19.5%)	643 (18.9%)
Persons with a disability	6 (1.4%)	62 (1.8%)
* In keeping with the Privacy Act, if the number of respondents who self-identified as belonging to one of the four groups is less than five, it is not provided to protect the privacy of the respondents. <i>Additional information is provided in Part 4 EDI report.</i>		

Figure 2.2: 2018 EDI Statistics from CFREF Secretariat

numbers as 178 GWF personnel did not complete the survey and Indigenous co-led water research projects started after it was taken. GWF will continue to implement practices that advance EDI and will strive to better our performance in meeting EDI principles (*see details in Part-4 EDI report*).

f) An updated performance measurement plan as of the mid-point of the grant

GWF has adopted an extensive performance measurement plan (PMP), including measuring Evidence of Global Research Excellence, and Attracting and Retaining Best and Brightest Talent. In almost all of the categories listed under the PMP, GWF is meeting or exceeding its targets. Please refer to *Part-5 PMP* of the mid-term report for details. The PMP relies on a common management strategy, that includes monthly and quarterly reporting contributing to reviews of scientific and technical progress by the OT (leads from 39 funded projects and 6 core modelling and forecasting, computer science, knowledge mobilization, and technical teams), and Annual Open Science Meetings (AOSM). This provides a broad perspective of scientific progress from the entire GWF program to stimulate transdisciplinary discussions and interactions amongst researchers, students, and partners, and to showcase and celebrate the scientific and technical advancements emerging from the GWF program.

As part of the PMP plan, all funded projects and core teams were requested to develop inception reports by April 30, 2018. The purpose of an Inception Report for each project was to establish a set of short-term plans and broader long-term plans, including contributions by specific co-investigators, collaborators, and teams within the project; timelines and deliverables; and, anticipated difficulties or gaps that need further consideration. It was intended as a guidance document to help in the planning and execution of project activities, as a benchmark to gauge progress, and as a tool to help identify and resolve key problematic areas, such as lack of resources, commitments, or person-power. It also clarifies important changes as the project has evolved and as users have been brought in since the funding announcement.

Project Annual Progress Reports - To fulfill GWF reporting requirements to CFREF against the performance indicators, individual PIs are required to provide written reports by April 30 each year. The technical, scientific, and knowledge mobilization goals from individual reports are then compared with respective Inception Reports to gauge the progress. If there is a significant departure between planned and actual progress towards milestones, then the matter is brought up to the SMC for further discussion with the potential to hold consultations with the PI.

Project Financial Reports - Reports are required from the PIs twice per year (April and October) indicating whether they are in compliance with the budgets included in their inception reports. PIs are required to provide justification if there is more than 20% variance in individual line items and seek approval if the line items are expected to deviate by more than 20% over the entire project. In addition, any impending issues raised during OT meetings are conveyed to the Director of Finance for resolution.

g) A summary of the key problems/challenges, risks and mitigation strategies.

Seven challenges were identified in the original proposal. Implementation of an effective and efficient management and governance strategy (see *section a.1*, above), combined with a highly efficient project and core team inception plan (see *section a.3*, above) has mitigated these challenges.

g.1 Program scale and scope impedes ability to achieve research objectives: The GWF program currently involves 189 faculty members from 18 Canadian universities, more than 478 partners, and is training 965 highly qualified personnel. As evident from *section (b)*, the program has met all of its stated milestones by mid-term and is operating efficiently. Its operating structure has permitted it to achieve its research objectives in a timely manner.

g.2 Geographic dispersion leads to siloed research activities and ineffective collaboration: The SMC decided to distribute funds competitively as informed by a rigorous peer review process so that the most transformative and transdisciplinary projects would prevail. The SMC insisted that funded projects be in alignment with the GWF mission, be driven by research questions proposed by partners (users/ stakeholder/ collaborators) or strong science or data needs, and involve the best team of researchers from across Canada having the appropriate research expertise. During the review and decision making process, the SMC worked to avoid siloed approaches by ensuring that the consortium-sized proposals addressed at least two of natural science, social science, and health science, as well as involved multiple institutions.

g.3 Inability to recruit/retain faculty and HQP to drive program forward. This has never been a hindrance to the network. Because of the strong reputations of the four partner universities and others in the area of water security, and also due to the geopolitical situation around the world, we were fortunate and very successful in attracting top faculty members (including a senior Canada 150 Research Chair in Hydrology and Remote Sensing, top US-NCAR and UK-NERC scientists) and close to 1000 HQP. In addition to the project-based and core team funding, GWF has piloted Capacity Building Awards, Summer Student Internships, Sabbatical Research Grants, and PhD Excellence Scholarships at USask to further strengthen research capacity and attract best-of-the-best graduate students globally.

g.4 Solutions do not align with national priorities or market needs. The transdisciplinary Pillar 3 projects and cores teams ensured that our research is highly relevant to 478 partners (see *Tables 7-9*). The core KM Team has been working closely with GWF projects and partners from project planning and inception through execution, ensuring outcomes of relevance to national priorities and market needs.

g.5 Inability to retain or broaden our base of partners. The original GWF proposal had 156 partners, which now has grown to more than 478 partners in 3 years. This is a testament to an effective and efficient network, transdisciplinary project development, strong knowledge mobilisation, and also careful and strategic planning on the part of the governance team.

g.6 Challenges in transferring knowledge, technologies, and solutions. Each project and the KM Team has been working closely with partners from planning to inception through execution of the project, which ensures there is a feedback and that the two-way exchange of knowledge, technologies, and solutions is a continual process.

g.7 Duplication with other potential freshwater programs. We have been successful in assembling and funding a large comprehensive team of almost 189 faculty from 18 Universities across Canada to address our mission and objectives. This ensured that there is only one comprehensive freshwater program in Canada. Indeed, GWF is the largest freshwater research program in the world, and is leading projects for the WCRP, UNESCO, WMO, and Future Earth. In addition, we have established a network of complementary freshwater research projects around the world, including links to the Water Security Alliance – the largest water network in the UK (signed MOU) and the Third Pole Environment program of the Chinese Academy of Sciences (signed MOU).

Since the declaration of a global pandemic the impact of COVID-19 has become apparent on all aspects of the GWF program. In March 2020, GWF began to transition to an online organisation and plan for a fully online annual open science meeting. This meeting did occur online in summer 2020 and is considered a success.