

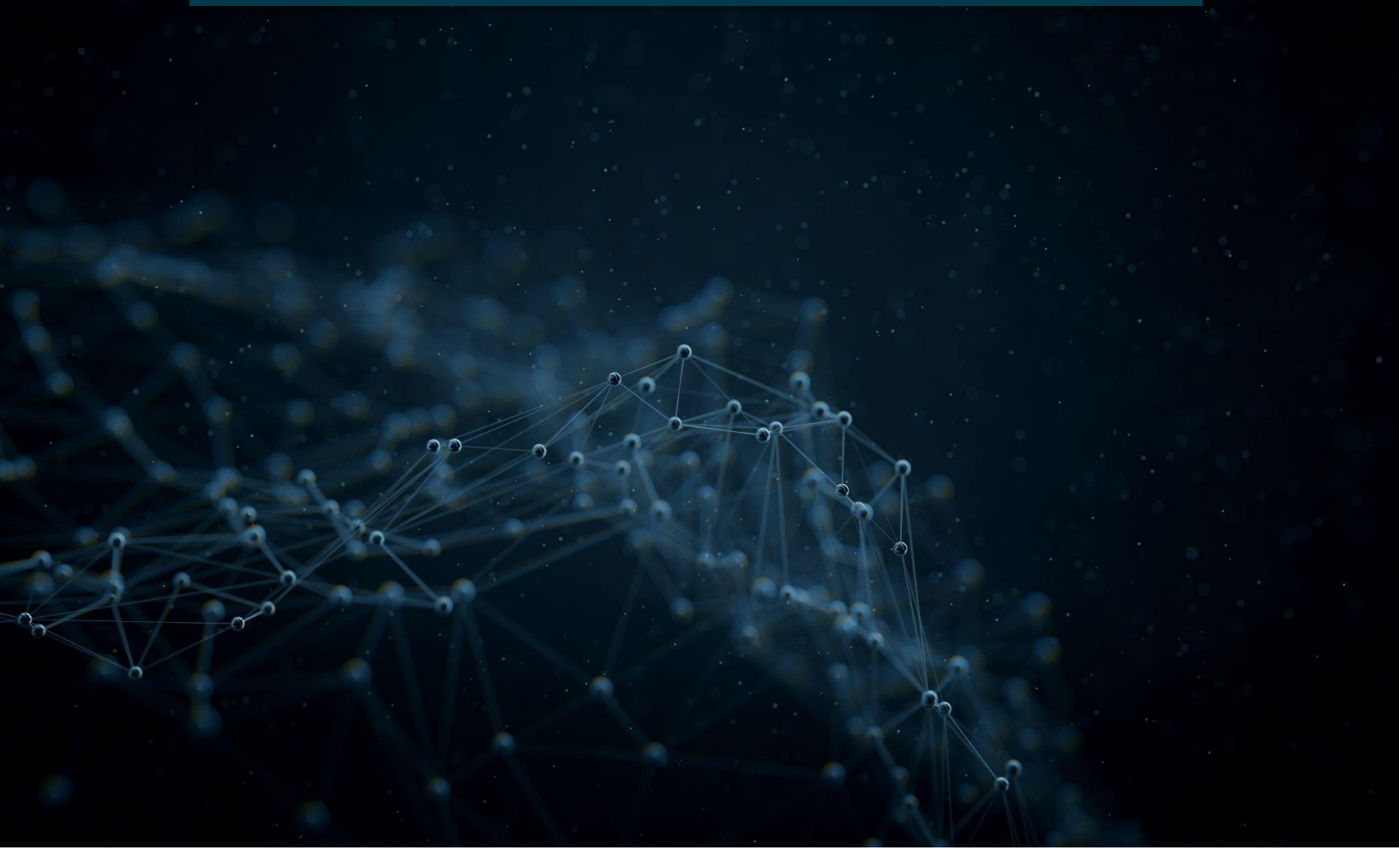
INNOVATION

Canada Foundation
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Fondation canadienne
pour l'innovation

2023–29
Major Science Initiatives Fund
Annual report
**** Global Water Futures
Observatories****

Submission date:
July 15, 2024



Cover letter

2023–29 Major Science Initiatives Fund

Annual report

CFI Project number: 42687

Name of the facility: Global Water Futures Observatories

Name of the administrative institution: University of Saskatchewan

Reporting period: 2023-24

By signing below, you acknowledge having received and read a copy of this report and further certify that all information incorporated in the document is true, accurate and complete, and that the facility's Board members have seen and approved the report.

Chair of the facility's Board

President or authorized signatory of the administrative institution

Name: Baljit Singh
Chair, GWFO Oversight Committee
Vice-President Research
University of Saskatchewan

Name: Phani Adapa
Director Research Acceleration &
Strategic Initiatives, University of
Saskatchewan

Signature: 
Date: July 29, 2024

Signature:
Date:

The information collected through this report will be used and disclosed in accordance with the CFI's policy around the Access to Information and Privacy Acts. In sharing information with the CFI, you also consent to the sharing of your data and information contained therein with the CFI's provincial and federal funding partners.

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About the Major Science Initiatives Fund

The Canada Foundation for Innovation's (CFI) Major Science Initiatives Fund (MSIF) provides multi-year support toward the operating and maintenance needs of unique research facilities of national importance. These facilities are owned by one or more CFI-eligible institutions, and they enable researchers in Canada to undertake world-class research and technology development that will lead to social, health, economic or environmental benefits to Canada.

CFI support obtained through the 2023 MSIF competition is intended to:

- Promote responsible stewardship through the adoption of best practices in governance and management
- Enable facilities to operate at an optimal level to ensure the best use of their specialized equipment, services, resources, and technical and scientific personnel
- Enable pan-Canadian research communities to undertake world-class research and technology development that lead to social, health, economic or environmental benefits for Canadians.

About the annual report

Annual reports, accompanied by financial reports, will be shared with external reviewers to guide their assessment of the facility, per the [2023 Major Science Initiatives Fund Oversight Framework](#). The level of review is driven by the risk profile of the facility and will be conducted in accordance with the process outlined in [Appendix 3](#). Additionally, the reports will be reviewed by CFI staff and key funding partners to guide risk assessment and performance monitoring. The reports also fulfill the CFI's reporting requirements laid out in its contribution agreement with the Government of Canada specific to the Major Science Initiatives Fund.

The release of funds for the subsequent CFI instalment will depend on the submission of satisfactory annual reports, financial reports and response to conditions (if any).

The data and information collected through this report will be used and disclosed in accordance with the CFI's policy around the Access to Information and Privacy Acts. It may be used for program evaluation or other analyses conducted by the CFI. Data from the report may be published in CFI material in aggregate. Information from the reports may also be used for communication purposes and help the CFI to showcase the accomplishments of the facilities. Any information that would be attributed to the facility and/or report would be published only after obtaining consent from the facility first. ***Information that cannot be shared publicly, such as information under embargo, should be explicitly identified as such in the report.***

Facilities must submit to the CFI an annual report for the first five years of funding and a final report in the final year in order to meet the requirements in the [2023 Major Science Initiatives Fund Oversight Framework](#). The deadline for report submission is June 15 each year. The template for the final report will be shared closer to the end of the funding cycle.

Instructions and guidelines for completing the annual report

The annual report consists of two parts: this text document (Part A) and a spreadsheet that comprises the actual values and year-six target for each of the standard and facility-specific key indicators and expenditures and contributions (Part B).

How to complete Part A

The CFI is looking for **clear and concise** text that reflects on changes and progress over the past year and what is planned for the coming years. You may also use illustrations, tables and graphs.

In Part A, integrate a discussion of the key indicators reported in Part B to frame the progress and achievements of the facility. The discussion of the indicators should describe the facility's current position and the steps it will take to reach the aspirational goal for year six. Address any obstacles or setbacks encountered along the way. Year-to-year values, trends and major annual variabilities should be explained with context.

[Appendix 1: Facility overview](#) must be filled out in year one. In the following years, the information should not be modified unless there are changes. [Appendix 2: Additional information](#) is optional.

The maximum number of pages for Part A of the report is 15 pages, excluding images, tables and graphs. The 15-page limit also excludes the Part A appendices. Use Arial, 10-point font and single-line spacing for your report.

Avoid duplicating information across years to facilitate the reviewers' and CFI's assessment of the annual reports.

How to complete Part B

The **spreadsheet** is a cumulative document that will be added to by the facility each year and submitted with Part A of the annual report. Please add the following:

- Actual values for the current year for each key indicator
- The facility's expenditures and contributions, as submitted in the financial report.

The definition, methodology and year-six target for each indicator should be entered as agreed upon at award finalization. If you require changes to your indicator definitions or methodologies, please contact the facility's CFI Senior Programs Officer.

How to submit the report

Submit annual reports by email to the facility's CFI Senior Programs Officer using the templates for Part A and Part B provided.

The report must be approved by the facility's Board of Directors and include a cover letter confirming the accuracy and completeness of the information (see page 2 of this document). The cover letter must be signed by both the Chair of the facility's Board and by the president or authorized signatory of the administrative institution.

Annual report – Part A

Objective: Promote responsible stewardship through the adoption of best practices in governance and management

1. Describe progress made toward meeting the facility's main strategic objectives, using the following format:
 - a. Main strategic objective
 - i. Progress made toward meeting the objective over the past year (refer to successes and challenges)
 - ii. Key deliverables relating to the objective for the upcoming year.

i. Progress made toward meeting the objective over the past year

GWFO supports transdisciplinary and transformative freshwater research to achieve three main objectives:

1. deliver new capability for providing disaster warning;
2. diagnose change and predict water futures; and,
3. develop new models, tools, and approaches to manage water-related risks.

The Global Water Futures Observatories (GWFO) facility supports these objectives by monitoring the causes of change in Canada's freshwater, helping support the development of Canada's national water prediction model, contributing to Canadian water security by support for federal and provincial water management tools and improved solutions for freshwater sustainability and serving as an early warning system for changes in Canadian freshwater, including disasters such as floods, droughts and water quality degradation. GWFO generates open access freshwater observation data to inform development and testing of water prediction models, monitor changes in water sources, underpin the diagnosis of risks to water security, and help design solutions to ensure the long-term sustainability of Canadian water resources. This requires adaptive operations and data management based on evolving user needs and best methods to deliver water information in actionable forms to our knowledge users. In the past year, we have identified **nearly 30,000 distinct users of our facilities and data**, including almost 20,000 users of instrumented sites, over 1,700 users of deployable systems, and over 8,000 users of the laboratories.

The facility has made great progress towards its objectives as detailed below.

Establishment of the GWFO User Advisory Panel: A User Advisory Panel (UAP) has been established for GWFO comprised of representatives from Indigenous communities, federal/provincial/municipal governments, water management bodies, industry, and practitioner and data user groups. The UAP is intended to build user engagement with GWFO and provide insights into the user science and decision support needs underpinned by the GWFO data, provide recommendations and avenues for translating GWFO's data to support the real-world impacts, and enhance scientific exchange with private and public sectors and Indigenous organizations and communities. The panel provides strategic advice in identifying and catalysing new opportunities to grow GWFO's user-base and services. There are now 39 members of the UAP, many of whom are new users. The member listing and terms of reference can be found at <https://gwfo.ca/about/management-and-advisory-committees.php> under the User Advisory Panel tab.

Implementation of GWFO: On February 29, 2024 the award agreement for GWFO (MSI 42687) was fully executed by CFI-MSI. Shortly after, the website was published (<https://gwfo.ca>), making available information on the facility, including its labs, instrumented sites, deployable systems, data management and access, personnel and committees, and other relevant details. A Director's Message was sent to a broad mailing list of 2,098 people on March 30, 2024 to announce GWFO's implementation and how to access the facility, including an invitation to the GWF Launch event held in April 2024, in person in Saskatoon, Waterloo and Windsor and online with many hundreds in attendance: <https://mailchi.mp/b927050fd33d/gwf-gwfo-director-message-march2024?e=8532b8f3d0>

Data Management and Access: GWFO's network of instrumented sites, deployable systems, and laboratories has been operating smoothly to provide critical freshwater observations for a vast range of users. Significant effort has gone into developing our data management system, facilitation of data access, and the GWFO Data Policy. We have put much thought and effort into developing a suitable data policy and now have an advanced draft policy under review with advice from the UAP and GWFO academics. We will finalise the Data Policy this summer. At its core, the Data Policy requires the open access and provision of all GWFO *Operational Data* (routine data collection) as part of the normal functioning of the instrumented site or deployable system, including, but not limited to hydrometeorological, cryospheric, water quality/quantity, ecological/biological, toxicological, and other water-related variables. It does not include special or unique research or custom campaigns or initiatives that are outside the normal operation of the facility and may be supported by the Fee for Service structure.

The GWFO data management system is an integrated information network consisting of:

- GWFO Website at www.gwfo.ca ,
- GWFNet metadata catalogue at <https://gwfn.net/> ,
- the GWFO Integration Website at <https://gwfo.gwfn.net> (not usually accessed directly, but rather it is accessed automatically and seamlessly through interaction with the GWFO Website),
- the WISKI database, an environmental time series data repository populated by telemetry systems and manually, <https://giws1.usask.ca/applications/public.html?publicuser=public#waterdatapublic/stationoverview>, and
- the Real-time GWFO Telemetry Data Visualization Website, <https://giws1.usask.ca:8443/index.html>.

GWFNet is a data catalogue and information management system for the Global Water Futures Observatories (GWFO) program and related information. It serves as a centralized cataloguing system to allow access to GWFO data, metadata, publications, and other important information related to water science about the observatories.

Key features of GWFNet include:

1. Data cataloguing: It provides a comprehensive catalogue of data generated at or on behalf of GWFO.
2. Publication tracking: The system includes records of publications resulting from GWFO-supported outputs from the observatories and laboratories.
3. Research site information: GWFNet contains details about observatories, research sites, and stations used in GWFO-supported research.
4. Geospatial/geolocation information: GWFNet can include geospatial information (geolocation points and contours which, in turn, can cross-link other records) in any of its information records related to, for instance, observatory sites and stations, data collection points and/or extents, and model application areas. Combined with record cross-linking, users can navigate to or from maps, and cross-linked related records to contextualize GWFO outputs not just to other records, but to locations on earth with related data/publications/sites/models.
5. Linked information records: The catalogue uses template-based information records that are cross-linked to provide a cohesive view of water science research.
6. Long-term data accessibility and scalability: GWFNet is designed to ensure ongoing public accessibility to large volumes of complex and disparate data and associated information and can be scaled beyond its current size with GWFO.
7. Freshwater science focus: GWFNet specifically caters to information related to freshwater sciences, aligning with GWFO strategic goals by making information readily at hand to inform development and testing of water prediction models, monitor changes in water sources, underpin the diagnosis of risks to water security, and help design solutions to ensure the long-term sustainability of Canadian water resources.
8. Integration with other repositories: Whilst GWFNet serves as a central catalogue, it also links to and contextualizes information from other national and international repositories and catalogues, such as FRDR, DataStream, GitHub, and to web services, such as the GWFO WISKI Web Portal (<https://giws1.usask.ca/applications/public.html?publicuser=public#waterdatapublic/stationoverview>).

By combining these features, GWFNet serves as a unique, advanced, centralized platform for managing

and disseminating the diverse outputs of GWFO, distinguishing it from more general water science databases or those focused solely on data storage. GWFNet plays a crucial role in managing and disseminating the vast amount of data by providing a centralized platform for the public sharing of well cross-referenced and integrated data, publications, and observatory site information and GWFNet supports the collaborative efforts of researchers consuming the GWFO outputs and helps to maximize their impact towards addressing water threats and developing solutions for sustainable water prediction and management.

WISKI (Water Information System by KISTERS;

<https://giws1.usask.ca/applications/public.html?publicuser=public#waterdatapublic/stationoverview>) is a commercial software system for storing and managing environmental data and it is ideal for handling hydrological and hydrometric time series data. The WISKI Web Portals enables online data access and visualization for the public and offers APIs for data integration and enhancement.

Our extensive **Telemetry System** consists of infrastructure to pass data from numerous GWFO dataloggers that monitor and control environmental sensors at the observatory sites into GWFO's WISKI system. So called *telemetry data* from WISKI is gap-filled and quality-controlled so that users have access to the best water data possible.

The **GWFO Integration Website** (<https://gwfo.gwfnet.net>) extends the functionality of the main Cascade-based GWFO website (<https://gwfo.ca>). The Integration Website makes available and stores information from user access requests for data and site visits, and also runs web services provided by GWFNet to obtain live information on observatory research sites (including GWFNet's live geolocation map of GWFO sites) and GWFO fee-for service prices (laboratory analyses and rental of deployable systems).

The **GWFO Real-time Telemetry Data Visualization Website** (<https://giws1.usask.ca:8443/index.html>) allows users to view actual observational data (e.g., temperature, precipitation, wind, radiation, etc.) from the stations at some of the observatory sites in near-real time. This visualisation system is a favourite with and of great interest to a variety of public users. Beginning this year, data visualization web pages are being upgraded to a new, modernized system. All existing sites are expected to be available on the new system by the end of this summer. These web pages are being linked to GWFNet and to information pages on the main GWFO website for ease of reference.

ii. Key deliverables relating to the objective for the upcoming year

Further Expansion of Network: As GWFO is now established and recognized as Canada's premier national scientific freshwater observation network, there is interest in bringing more researchers, instrumented sites, and institutions into the network on a no-exchange-of-funds basis, with both GWFO and the prospective university exchanging in-kind resources. This would be a formal expansion to universities that have instrumented long-term freshwater research sites tended by technicians and that provide unique, high-quality water data. We are currently in discussions with the University of Calgary, Université du Québec à Montréal, Dalhousie University, and the University of Northern British Columbia which would permit expansion of GWFO from British Columbia to Québec and Atlantic Canada.

2. With reference to how they may impact the facility's strategic direction or management plan, describe any major environmental shifts in the past year, such as new regulatory developments, rising competition, changes to the geopolitical landscape or funding challenges.

Very recently, two major pieces of legislation were passed in the House of Commons, which were outcomes of discussions with GWFO and influenced by the science and the policy implications of GWFO data. The first is Bill C-59, the enabling legislation for the creation of the Canada Water Agency (CWA) as an independent federal agency reporting to a Minister, which received Royal Assent on June 20th, 2024.

The CWA will be based in Winnipeg and have a freshwater data management/data portal role. GWFO has offered to help inform the development of that data management system/portal and we expect to link to it. We anticipate an increase in GWFO data usage from the new CWA. We are also in discussions about funding from the Government of Canada that would be coordinated by the CWA. The second is Bill C-317, An Act to Establish a National Strategy Respecting Flood and Drought Forecasting, which is currently at second reading in the Senate. This would require the Minister of Environment and Climate Change Canada to explore setting up a national cooperative forecasting and prediction system inclusive of all provinces and territories. Such a system would benefit from GWFO data for testing and developing its prediction models and assimilating GWFO observatory data directly into its forecasting systems. In both instances, GWFO infrastructure, data, and scientific outcomes represent crucial contributions and underpin these initiatives.

3. **Describe any significant incidents (e.g., health and safety near miss, data breach) in the past year. Explain how these incidents were managed and mitigated. Refer to the facility's risk management strategy outlined in question 5 of [Appendix 1](#).**

There have been no health and safety near misses or data breaches during the last year. The Data Management team ensures that all data and software systems described in the "**Data Management and Access**" subsection are solidly backed up. For a brief period during 2023, live views of telemetry data were not being updated because of communications issues with older servers at the University of Saskatchewan (note that no data were lost in the WISKI database as fallback procedures were employed to maintain data integrity). By February of 2024, the problematic servers were replaced and the live views were restored to working condition.

Objective: Enable facilities to operate at an optimal level to ensure the best use of their specialized equipment, services, resources, and technical and scientific personnel

4. **Describe any changes to the facility's user community(ies) over the past year, including changes in user demand. Discuss measures taken to attain optimal use of the facility's resources, including changes to user access policies and selection processes. Refer to the Users, Optimal Use and Demand indicators.**

This is the first year of operation for GWFO and we had not previously tracked users and use in the manner that we are now. After conducting a comprehensive assessment of these metrics we discovered that they were much higher than we had anticipated for this year. Our baseline is 4660 users from the latest available GWF information (1722 on-site users, 46 remote users, 2892 data users). However, reporting by all GWFO facility leads for Year-1 has shown much greater use of GWFO, with 29,688 total users (9539 on-site users, 287 remote users, 19,862 data users)—a significant increase from our GWF baseline and an important indicator of the uptake by, and value of GWFO to the user community across Canada and internationally.

In calculating optimal use of GWFO we used a weighted average of the percentage use of the instrumented observation sites (64), the deployable systems (15¹), and the water laboratories (18). We calculate overall use of GWFO to be at 94% compared to optimum, with observatory use of 98%, deployable system use of 96%, and laboratory use of 78%. Our initial estimate for a baseline use of 100% (i.e. optimal use) was likely flawed as we had not previously tracked such indicators as usage and

¹ Note that we have queried and precisely inventoried our deployable systems and count a total of 15 separate systems or lab bases of systems, while the documentation provided to CFI earlier estimated 14 systems. See <https://gwfo.ca/facilities/deployable-systems.php> for the listing.

downtime, but it is notable that we are operating quite close to this baseline and we are exceeding what we anticipated as a year-6 target (i.e., 75%).

We have seen exceptional new interest in data associated with pan-Canadian drought conditions in the prairies, boreal forest, North and mountains in 2023 and early 2024 that resulted in wildfires, record low river flows, reduced hydroelectricity generation and agricultural drought. This was reflected in an increase in requests by media for expert opinion from GWFO as shown in the Outreach statistics.

5. Explain any changes to user satisfaction over the past year. Discuss measures taken to address concerns and enhance user experience. Refer to the Satisfaction indicator.

In the first year of operation of GWFO, we have implemented a GWFO User Advisory Panel to ensure user satisfaction and to suggest ways in which this can be improved. We are developing an online User Satisfaction Form (which is expected to be available in September) for all GWFO on-site, remote, and data users that they will be asked to fill. We are requesting the site leads, staff, and members of the Strategic Management Committee to suggest areas for improvement in user satisfaction from data collection to site visit requests to laboratory and deployable system rentals.

6. Describe key outreach and engagement activities conducted with both research and general communities in the past year to build awareness of the facility's evolving capabilities and services. Highlight the impact of these activities on attracting new users and stakeholders. Refer to the Outreach indicator.

GWFO site leads and personnel have been very active in outreach activities to promote the facilities and the science that is supported by GWFO. In Year-1 (2023-24) there were 45 courses, workshops, training sessions and summer schools offered by GWFO or its individual facilities. There were 17 stakeholder or public events hosted by GWFO and there was substantial media engagement, with facility leads and other personnel involved in 186 media interviews, press conferences, broadcasts, podcasts and press conferences. GWFO facility leads and other personnel have participated in 159 stakeholder events (e.g., presentations to potential industry/government/community partners; booths at trade shows/conferences/conventions/exhibitions/fairs). This outreach has taken place across Canada in a wide variety of settings, from small, private gatherings in local communities to large events in public venues, and in every region where our facilities are located and we take active measures to engage with the users and the public. We continue this effort into the start of Year 2 and some of the more recent and major activities are described below.

GWFO Launch Event: On April 17th, 2024 GWFO and its partner institutions hosted a nationwide launch and celebration of GWFO (<https://gwf.usask.ca/events/2024/04/gwfo-launch.php>). The event was hosted at the University of Saskatchewan (USask) with simultaneous in-person gathering events at the University of Waterloo and the University of Windsor. The event was also streamed online (Zoom). It included an overview of the program, remarks from users/partners including the Parliamentary Secretary and Special Advisory on Water to the Prime Minister, and brief summaries from each of the main GWFO partner institutions, as well as a showcase of some of the sensors and deployable systems. There were over 260 individuals who attended online or in person from over 50 different organizations and six countries. The Launch generated significant media coverage and a press conference at USask, leading to many news articles (see <https://gwfo.ca/resources/media-reports.php>), and subsequent follow-up from interested potential partners and data users. The Launch event has been viewed 73 times and can be viewed at: <https://youtu.be/uX89uuGhPqM>

Canada Water Resources Association (CWRA) National Conference: The CWRA held its National Conference in Saskatoon, SK, on June 16–19, 2024 (<https://conference.cwra.org/>; Theme: Bridging Water

Research and Practice—Mobilizing our Collective Knowledge) and GWFO had a major role in shaping this conference and contributing relevant science, policy, and management solutions. The conference included attendees representing a broad range of practitioners, water managers, non-governmental organizations, community members, Indigenous Nations, and academics. This began on the evening of June 16 with a public event on *Sustainable Prairie Water Management* that included remarks and reflections from panelists, including Professor John Pomeroy (Director of GWFO) and other experts and sectoral representatives, on the challenges and priorities surrounding water resources on the Prairies (<https://conference.cwra.org/program/cwra-public-event/>). At the conference, a scientific session was convened by members of the GWFO Strategic Management Committee and Secretariat titled, Global Water Futures: Synthesis of Solutions to Water Threats in an Era of Global Change, showcasing many of the results and outcomes from GWFO data and highlighting the importance of observations. A GWFO exhibitor booth was also hosted during the conference. Over 150 attendees visited the booth to engage with GWFO outreach and knowledge mobilization personnel and outputs and to learn about how the facility can support their communities, research, or policies. Examples of some key conversations include:

- A researcher from Natural Resources Canada needing historical streamflow records in the Kananaskis region to support their ongoing research about fish habitat;
- A consultant working on coal mine rehabilitation in British Columbia needing environmental data from GWFO sites just over the border in Alberta;
- How GWFO data could support the validation of a University of Lethbridge project on estimating water equivalency of snowpacks at the end of winter in the eastern slopes of the Rocky Mountains;
- How GWFO data and fee-for-service technicians could support the Turtle Lake community with water quality and quantity concerns they are currently trying to assess;
- Soil water researchers and modellers from Ontario were excited by the prospect of access to GWFO's soil-water laboratories and data from their region of interest;
- The Okanagan region is keen on maintaining a relationship with GWF and GWFO as wineries and fruit producers are very concerned about their water future;
- In general, many graduate students and non-profit organizations were excited to go to the website to see what data was available and how it could support their research;
- Multiple research leads were interested in learning if there was an opportunity to have their sites join GWFO.

A vast majority of the engagement we had was about available data, including the quality and long-term records of the data.

GWFO website: The GWFO website went live on April 11, 2024, and was officially launched with the GWFO Launch Event on April 17, 2024. www.gwfo.ca The University of Waterloo has also launched a website that is specific to the GWFO facilities at that institution (<https://uwaterloo.ca/global-water-futures-observatories/>). These websites provide comprehensive information and relevant links to our systems, services, data, and the network in general. From April 11 to July 1, there have been a total of **2,725 page views** from **725 unique users** on gwfo.ca.

The top 5 most-viewed pages were:

1. [Homepage](#) (1,124 views; 636 users)
2. [Instrumented Sites](#) (393 views; 92 users)
3. [Major Laboratories](#) (290 views; 59 users)
4. [Deployable Systems](#) (173 views; 42 users)
5. [Staff & Personnel](#) (110 views; 53 users)

Judging from the above numbers, users appear most interested in what sites, labs, and equipment GWFO is linked to.

Top 5 countries for most unique users:

1. Canada (415 users; 2,337 page views)
2. United States (193 users; 213 page views)
3. Germany (20 users; 19 page views)
4. United Kingdom (15 users; 29 page views)

5. China (14 users; 22 page views)

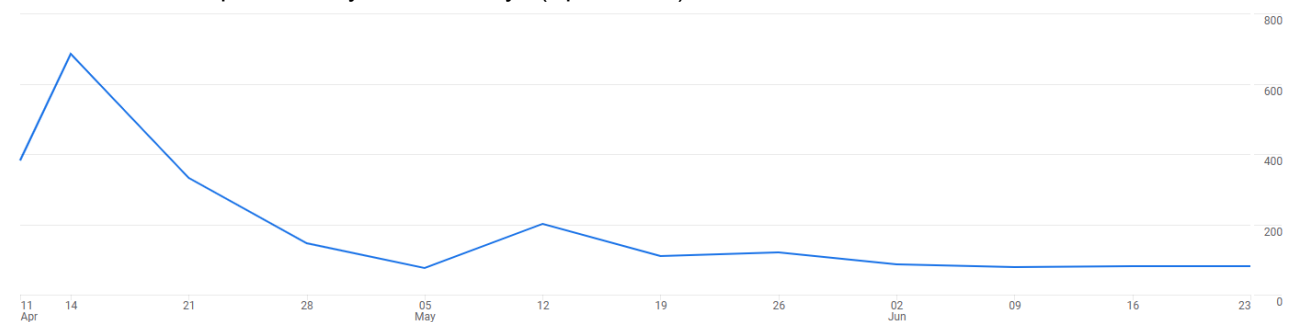
Top 5 cities for most unique users in Canada:

1. Saskatoon, SK (85 users; 1,570 page views)
2. Toronto, ON (85 users; 98 page views)
3. Quebec City, QC (84 users; 87 page views)
4. Ottawa, ON (20 users; 54 page views)
5. Calgary, AB (17 users; 64 page views)

Judging from these numbers, we have the most frequent and engaged users in Saskatoon and Toronto, with Quebec City not far behind.

The relationship between the number of users and page views can tell us how many returning users we have for each page or geographic location. Instances which have a much higher number of views than users imply that the same users keep coming back to the website or page. Instances which have close to equal users and views imply that more users are looking at the site or page once and not returning as often.

The below chart displays number of page views per calendar week from April 11 until June 29, over time. Note that the first point is only for three days (April 11-13).



Other engagement of partners and users: Over the past several months we have had many interactions with existing and new partners, collaborators, and interested user groups. We have met with the Oceans Network Canada CFI-MSI project to discuss synergies and commonalities, including sensors and systems, science overlap, best practices in data management, and program management and oversight. We have met with the US NSF-funded National Ecological Observatory Network (NEON), with whom we share many similarities and several areas of common interest in aquatic ecology with a potential focus on transboundary water relationships. We have discussed data collection and the potential for a joint workshop on science applications. We have met with the US NOAA-funded Cooperative Institute on Research to Operations in Hydrology (CIROH) who are interested in using research basin data as testbeds for hydrological model development. Other interested user groups approached us following our Launch event. These include Holland College in Prince Edward Island, who are concerned about groundwater sustainability and monitoring and looking for guidance on best practices for a monitoring network, and The Mosaic Company who are interested in new technologies and observation practices for environmental monitoring at their potash mining operations. Other discussions have been held with Environment and Climate Change Canada, Agriculture and AgriFood Canada, the Canada Water Agency, World Climate Research Programme's Global Energy and Water Exchanges (GEWEX) Project, World Meteorological Organisation, Canadian Water Resources Association, International Association for Great Lakes Research, City of Saskatoon, the Meewasin Valley Authority, BHP mining, Living Lakes, AAFC Living Lab - Bridge to Land-Water-Sky, American Geophysical Union, Alberta Water Council, Saskatchewan Water Council, Ontario Ministry of the Environment, Conservation and Parks, North American Drought Monitor, Prairie Provinces Water Board, Alberta Agriculture and Irrigation, National Farmers Union, Ducks Unlimited Canada, and Yukon Environment on how GWFO data can support their interests and mandates.

GWFO has been approved to carry on as the only North American Regional Hydroclimate Project of the World Climate Research Programme (<https://www.gewex.org/panels/gewex-hydroclimatology-panel/regional-hydroclimate-projects-rhps/>) and its data will be used to evaluate and develop global climate and hydrology models from countries around the world.

Indigenous partners. Indigenous communities play an important role in enhancing the content of GWFNet through several key contributions. For instance, GWFNet includes data from Indigenous co-led projects that address various water-related issues such as water governance and security (water quantity and quality) and how these issues are intensified with climate change. These projects advance the understanding of traditional knowledge alongside Western scientific indicators.

This base information in GWFNet is now being expanded through the activities of GWFO and many of these activities may positively impact Indigenous and other local communities. These data help Indigenous communities understand and prepare for future climatic trends and their impacts on water resources. The information in GWFNet is also being augmented as GWFO helps to manage data for the *Bridge to Land Water Sky* initiative at Mistawasis Nêhiyawak which will include measurements on water and soil in Saskatchewan. Indigenous communities not only contribute valuable knowledge and perspectives to information contained in GWFNet, but also ensure that the information and consequent research outcomes are beneficial and relevant to their communities.

DataStream Partner. The Gordon Foundation's DataStream is a national, open-access, online platform designed to share citizen science and other water quality data. DataStream serves as a crucial tool for communities, policy-makers, and researchers to access and share water quality data, ultimately supporting informed decision-making, engaged citizens and collaborative efforts in freshwater protection across Canada. Data and publication information in GWFNet, as these pertain to water quality issues, are being linked to DataStream records (and vice versa) to provide context to GWFO freshwater data.

7. Outline any major funding attracted by the facility over the past year and describe the impact of the new funding on the facility's operations. This may include funding that will contribute directly to the MSIF budget (i.e., "matching" funding) or other major funding attracted by the facility.

In July 2024 we secured a partial match for operations in Ontario with a \$540,000 grant from the Canada Water Agency's Freshwater Ecosystem Initiative to the University of Windsor (Professor Aaron Fisk) for Great Lakes scientific observation. We are in advanced discussions with the Governments of Alberta (Alberta Innovates, Alberta Agriculture and Irrigation, Alberta Environment and Protected Areas), Saskatchewan (Water Security Agency, Innovation Saskatchewan), and Canada (Environment and Climate Change Canada, Agriculture and AgriFood Canada, Canada Water Agency) and are optimistic about obtaining further matching funds before our current matching funds run out at the end of March 2025.

The facility and use of its data have triggered new research funding of \$461,972 from the US-NOAA Cooperative Institute for Research to Operations in Hydrology (CIROH) to USask for improving water resources modelling in cold regions, \$264,000 from Alberta Innovates for research on managing and predicting the impacts of forest and climate change on Alberta hydrology, \$73,590 from the European Space Agency to develop new artificial intelligence techniques for remote sensing of mountain snow, and \$65,000 from Environment and Climate Change Canada for upgrading the Yukon River Basin forecasting and prediction model.

An NSERC Alliance – MITACS Accelerate grant with support from Yukon Environment and Wildlife Conservation Society Canada will provide \$1,300,000 to expand Wilfrid Laurier University's fire ecology observatories into the Yukon (Baltzer). WLU has also received Polar Knowledge Canada funding to

support northern community engagement in our existing fire ecology observatories (\$35,000; Bältzer), and \$450,000 to support the Dehcho Fish Ecology Observatories from National Research Council of Canada (Swanson). A Government of Northwest Territories Environmental Studies Research Fund grant will provide \$300,000 (\$100,000 per year for 3 years, 2024–2027) to support research and operations at the Bogg Creek site in the Northwest Territories (Rudolph). These are not matching funds but supplement equipment, outreach and engagement at GWFO sites.

8. If applicable, describe any major infrastructure upgrades or additions made by the facility over the past year.

No major infrastructure upgrades or additions have been made to the GWFO facility in this fiscal year.

9. Describe how the facility has maintained or enhanced the knowledge, skills and performance of its technical and scientific staff over the past year. Highlight efforts by the facility to attract and retain staff. Refer to the Staff indicator.

GWFO has held several staff familiarization meetings with both scientific and technical staff. Staff have attended Canadian annual scientific meetings of the Canadian Geophysical Union, Canadian Water Resources Association, International Permafrost Association, and International Association for Great Lakes Research to develop and enhance their technical and science skills. Staff profiles have been developed and job reclassifications are under way for the Secretariat staff to reflect their GWFO roles.

The Data Management team has held a *Data Simplified and Open Science Workshop* for the GWF students & young researchers group, November 15, 2023, alongside several one-on-one trainings for researchers to train them in data management principles, using different websites and data platforms. In addition, we are going to have more training sessions for current and future GWFO data users during fall 2024.

We note some changes in our staff indicator numbers from what was previously documented and reported. Our original numbers and our budget are based on 52.8 full time equivalent (FTE) positions and we have maintained that in Year-1. The number in our Year-1 report show 55.3 FTE, but this is accounting for specific personnel that we have employed during the first year, some of whom have moved on and others who are new recruits. This is a continuously evolving part of the program with staff recruitment and loss, but the overall number of personnel supported with CFI funds remains unchanged on average. We have modified some of the categories or classifications of personnel, on some reflection about the nature of their duties and support to GWFO. The most important change here is the scientific positions—these personnel were moved into the technical support category as that is more fitting with their role (i.e., data managers). The CFI funds are not supporting purely scientific roles, only the technical and operational roles.

10. Provide a short list of new collaborations and partnerships developed by the facility over the past year, including organizations involved and the objectives of collaborations.

As noted in other responses, we are building new linkages with many universities, research and monitoring networks, NGOs, citizen science groups, community organizations, and colleges. As we have various discussions with interested parties, we are considering what expansion and scalability is possible and desirable for GWFO. Importantly we are an academic research data network and will stay true to our principles of operation for providing unique and trustworthy water data. We are looking into formal expansion of GWFO to include several more universities (UCalgary, UQAM, Dalhousie, UNBC), and outreach linkages with other groups such as DataStream where we can provide guidance, explore data interoperability and joint promotion of data use, and look for resources to expand our data management system.

Objective: Enable pan-Canadian research communities to undertake world-class research and technology development that lead to social, health, economic or environmental benefits for Canadians

11. Explain how the facility's collaborations and partnerships have helped to deepen the impact of its activities over the past year.

GWFO has over 500 collaborations and partnerships with users across Canada and around the world that have been formalized by exchange of letters of interest. These links have developed tremendous impact such as data for and design of enhanced mountain observations and predictions as part of the UN International Year for Glaciers' Preservation – 2025, the Global Cryosphere Watch program of the World Meteorological Agency, the UNESCO Chair in Mountain Water Sustainability, the World Climate Research Programme's GEWEX International Network for Alpine Research Catchment Hydrology, and Environment and Climate Change Canada's Canadian historical snow database CanSWE. GWFO data supports flood and drought forecasting and water allocations by provincial governments (Yukon, NWT, Alberta, Saskatchewan), National Water Model development by the federal government, operation of major water treatment and supply facilities (Buffalo Pound, SK – Regina/Moose Jaw; Union Water Supply System, ON – Leamington/Wheatly Greenhouse Industry).

Internationally, GWFO has worked with local scientists, knowledge holders, and decision makers to build capacity, raise awareness and exchange new information on water in all inhabited continents and has worked with UNESCO, WMO, Future Earth, the Water and Climate Coalition and various other organisations and countries to help gain support for a resolution at COP27 for enhanced climate monitoring and early warning systems, especially in cold regions, and in the United Nations General Assembly for a resolution declaring 2025 as the International Year of Glaciers' Preservation and March 21st as the World Day for Glaciers.

12. Describe the facility's contribution to the training of highly qualified personnel over the past year, including details on the high-level skills acquired and information about the career path of these personnel, highlighting challenges faced. Refer to the Training indicator.

Over 2023–2024, GWFO has contributed to the training of 46 undergraduate students, 133 Masters students, 120 PhD students, and 47 Post-Doctoral Fellows, as well as 141 other scientific and technical personnel that are not employed in GWFO. These individuals have received exceptional training and learned valuable skills in water science, data use, computational hydrology and other related fields. Many that have moved on have been recruited into various roles in federal and provincial water management and forecasting, academia, industry and consulting, and other career paths. This represents a new generation of young water professionals and future leaders.

13. Research and technology development

- Describe the past year's key achievements in the main research programs (by discipline, theme, project or experiment). Highlight research outputs, which may include publications, presentations, science promotion activities, software or databases. Refer to the Research Outputs indicator.

GWFO, has enabled scientific results that have had tremendous impact and produced a wealth of new results, new policy and management solutions, and actionable scientific knowledge on how we can best forecast, prepare for and manage water futures in the face of dramatically increasing risks. Scientific publications supported by GWFO data, infrastructure and secretariat are the largest of any freshwater grouping in the world—since 2017 there have been well over 4,000 publications. GWFO data supports the first continental-scale water prediction models for Canada, which are being deployed to predict the impacts

of climate change on water supply and quality, providing decision-support for improved water management. These sophisticated predictive modelling platforms support strong collaboration with provincial and territorial flood-forecasting agencies and Environment and Climate Change Canada and one, MESH, has recently been designated the ECCC National Hydrological Service's National Water Model. Models developed using GWFO data are being applied in other parts of the world in partnership with UNESCO and the World Meteorological Organisation (WMO). GWFO data supports the NOAA Cooperative Institute for Research to Operations in Hydrology (CIROH) in its efforts to redevelop the US National Water Model.

In the past Year-1, GWFO has supported 904 scientific outputs, including 316 peer-reviewed publications, 100 other publications such as newsletters and magazine articles, 3 conference proceedings, 472 presentations at conferences, and 13 books or chapters. This is close to our baseline value of 966 from GWF, with a slight decline that is due to the completion of some GWF projects and the slow down and wrap up of that science. Our Year-6 target for grand total of research outputs is 725 and we are currently exceeding that. CFI funding is not supporting scientific analyses and the development of models and predictive tools, but rather the operational support for GWFO. As we secure further funding for scientific activities, we expect to be able to continue to be highly productive in writing papers and disseminating the new science.

14. Technology transfer

- Describe the technology transfer enabled by the facility over the past year, including collaborations with industry, generation of intellectual property and supporting of startups. Refer to the Technology Transfer indicator.

GWFO has worked with the new AAFC Living Lab project Bridge to Land-Water-Sky (<https://www.bridgetolandwatersky.ca/>) to help them define their data management needs and make use of GWFO's data management system, GWFNet. This could include their customizing the system for their own development. This is the only Indigenous-led Living Lab project in Canada.

There have been 6 technical and consultancy reports produced in the last year, down from 60 the previous year under GWF. As GWFO is operationally-focused on maintaining facilities and scientific support data, there will likely be much less technology transfer than had occurred in GWF. A strong and continuing area of technology transfer is in data management systems and support, with the new GWFnet (www.gwfnet.net) system being the main technical development in GWFO.

15. Knowledge translation or mobilization

- Outline the facility's knowledge translation and mobilization activities undertaken over the past year, extending beyond the research community to include the broader public, policymakers, clinicians and various stakeholders outside academia. Describe some of the major benefits arising from these activities.

A Knowledge Mobilization Action Plan for GWFO (see <https://gwfo.ca/documents/km-for-gwfo-action-plan-june-2024.pdf>) was prepared and is guiding developmental activities related to data discovery and delivery, capacity building, network building, ongoing scanning of the user community, user engagement and tracking, and institutional evaluation. Work in the reporting year has focused on inventory and identification of existing and potential interactions with research partners, collaborators and data users to both support synthesis of GWF research and to plan for effective engagement and expansion of GWFO's user community. This has included a focus on the potential of research metrics to better understand initial steps of data re-use by scientists, practitioners, and policy makers <https://harvest.usask.ca/items/fb31566f-2498-4d38-b90c-e5acd6b4f059>.

Fully tracking the use of the data stewarded and shared by GWFO will involve harvesting and combining data from multiple sources. This includes the data repositories – both general purpose and specialised platforms – used by GWFO and its partner institutions to store, preserve and provide access to individual

datasets. Views, downloads, and citations in scientific literature are tracked by some of these and, while not providing full evidence that data have been used in societal contexts, they provide an indication that data are moving to contribute to building more knowledge. Interoperability of these systems, depending largely on shared standards, is perhaps the largest challenge in using their content and metadata to find patterns in the use of GWFO datasets. This reporting year, we began the process of investigating how to do this with the 16 external or partner repositories that contain GWFO data:

- Borealis/Scholars Portal
- CaSPAr (Canadian Surface Prediction Archive)
- Cuizinart
- Datastream
- DRYAD
- Environmental Data Initiative Portal
- Figshare
- Fluxnet/Ameriflux
- FRDR
- GitHub
- Government of Canada Open Data Portal
- HydroShare
- ORNL DAAC
- Pangaea
- Polar Data Catalog
- Zenodo



Statistics

Top Country Views	
Canada	2660
United States	1642
Unknown Country	252
China	188
Germany	152
Russia	142
Bulgaria	120
United Kingdom	94
Netherlands	88
France	64

Publications Citing ABoVE: Synthesis of Burned and Unburned Forest Site Data, AK and Canada, 1983-2016

The following 6 publications cited the product [ABoVE: Synthesis of Burned and Unburned Forest Site Data, AK and Canada, 1983-2016](#)

Year	Citation
2023	Mosharik, M., S. Sirtta, S. Potter, S.M. Natali, and B.M. Rogers. 2023. Carbon emissions and radiative forcings from tundra wildfires in the Yukon-Kuskokwim River Delta, Alaska. <i>Biogeosciences</i> . 20(8): 1537-1557. https://doi.org/10.5194/bg-20-1537-2023
2023	Potter, S., S. Cooperdock, S. Veraverbeke, X. Walker, M.C. Mack, S.J. Goetz, J. Baltzer, L. Bourgeau-Chavez, A. Burrell, C. Dieleman, N. French, S. Hanton, E.E. Hoy, L. Jenkins, J.F. Johnstone, E.S. Kane, S.M. Natali, J.T. Randerson, M.R. Turetsky, E. Whitham, E. Wiggins, and B.M. Rogers. 2023. Burned area and carbon emissions across northwestern boreal North America from 2001–2019. <i>Biogeosciences</i> . 20(13): 2785-2804. https://doi.org/10.5194/bg-20-2785-2023
2023	Zhu, X., X. Xu, and G. Jia. 2023. Recent massive expansion of wildfire and its impact on active layer over pan-Arctic permafrost. <i>Environmental Research Letters</i> . 18(8): 084010. https://doi.org/10.1088/1748-9326/acd2050
2022	Phillips, C.A., B.M. Rogers, M. Elder, S. Cooperdock, M. Mosharik, J.T. Randerson, and P.C. Ennaff, 2022. Escalating carbon emissions from North American boreal forest wildfires and the climate mitigation potential of fire management. <i>Science Advances</i> . 8(17). https://doi.org/10.1126/sciadv.abc7161
2020	Dieleman, C.M., B.M. Rogers, S. Potter, S. Veraverbeke, J.F. Johnstone, J. Laflamme, K. Solvik, X.J. Walker, M.C. Mack, and M.R. Turetsky. 2020. Wildfire combustion and carbon stocks in the southern Canadian boreal forest: Implications for a warming world. <i>Global Change Biology</i> . https://doi.org/10.1111/gcb.15139
2020	Walker, X.J., B.M. Rogers, S. Veraverbeke, J.F. Johnstone, J.L. Baltzer, K. Barrett, L. Bourgeau-Chavez, N.J. Day, W.J. de Groot, C.M. Dieleman, S. Goetz, E. Hoy, L.R. Jenkins, E.S. Kane, M.A. Parrison, S. Potter, E.A.G. Schuur, M. Turetsky, E. Whitham, and M.C. Mack. 2020. Fuel availability not fire-weather controls boreal wildfire severity and carbon emissions. <i>Nature Climate Change</i> . 10(12): 1130-1136. https://doi.org/10.1038/s41558-020-00970-8

FRDR and ORNL DAAC tracking of views and citations of GWFO data

GWFO's metadata catalogue, GWFNet, continues to capture descriptions and locations of datasets collected from its network of observatories. We are working to further develop GWFNet's capacity to cross reference observatories, researchers, datasets, and resulting literature. In parallel, we are looking at ways to efficiently combine these data with usage statistics from repositories to provide a clearer picture of dissemination and uptake.

GWFO outcomes have been shared and translated to a broad range of users and partners, and these have informed policy and had impact on the activities of various groups.

Top Media Stories:

- [This season's widespread, severe wildfires will have long-lasting impact on N.W.T.'s boreal forest](#) – CBC News North
- [Ice-road challenge](#) – The Globe and Mail
- [More than 70% of Canada is 'abnormally dry.' Here's why](#) – CTV News
- [Canada's Dry: "We're in a new game here"](#) – The Big Story podcast
- [Dry January: why a dash of snow and rain can't solve B.C.'s water woes](#) – The Narwhal
- [The water gets hotter and the frog just sits there](#) – Canada's National Observer (Op-Ed)
- [Record Sask. snowfall won't overcome years of 'unprecedented' drought, hydrologist says](#) – CTV News Saskatoon

- [New chapter of water data begins for Global Water Futures network](#) – Environmental Science & Engineering Magazine (online)

GWF & GWFO contributions to major reports:

- [The Future of Freshwater in Canada](#), A Joint Report by the Forum for Leadership on Water, Massey College and the United Nations University Institute for Water, Environment and Health
- [Ensuring Canada's freshwater future](#) – Case Study by Innovation Canada
- [The Canadian Mountain Assessment: Walking Together to Enhance Understanding of Mountains in Canada](#) – Report
- [State of the Global Water Resources 2022](#) - WMO Report

Virtual Water Gallery:

A new series of short videos looking behind the collaborations that were part of the Virtual Water Gallery have started to roll out. The Virtual Water Gallery depicted many GWFO observatories and their cultural and scientific context in innovative art.

- Behind the Exhibit: Life Support: <https://youtu.be/W0Dc-E9OfWk?si=qS4IOG1ZXqs0S7AZ>
- Behind the Exhibit: Deep Time: <https://youtu.be/jDALuIqhg4w?si=vS-IAJ8fDRSeKUT>

New galleries added to the Virtual Water Gallery (May 2023):

- Athabasca - An Album of Eco-Songs: <https://www.virtualwatergallery.ca/athabasca>
- Behind the Science: <https://virtualwatergallery.ca/behind-the-science>
- Hosted a public-facing Virtual Water Gallery exhibit showcasing the sci-art (May 2023) in Saskatoon, SK.

GWFO on social media:

Instagram:

- 679 followers

LinkedIn:

- 2,347 followers

Twitter:

- 4554 followers

GWFO has become a recognised source of information about the patterns and effects of climate change, as has been mentioned in Section 4 with the increased public concern related to drought on the Canadian Prairies, and invitations by government bodies to provide expert advice. This recognition is accompanied by challenges as localised and variable weather patterns call science – and public expenditure on the data collection and stewardship that supports the science – into question. We believe that continued advocacy for GWFO's work is an essential element in effective use of its data.

https://www.linkedin.com/posts/monica-morrison-knowledge-mobilisation-investing-in-data-stewardship-to-guide-canadian-activity-7187213460571582464-HWXi?utm_source=share&utm_medium=member_desktop

Response to conditions

16. If applicable, briefly describe actions taken to address conditions of the CFI award agreement.

1. The facility needs to evolve its governance model in order to be more reflective of a national research facility. The physical & human resources of the facility should be managed centrally. The services that the facility offers need to be well defined and transparent to users. Services should be accessible through a centralized entry point.

GWFO's Oversight Committee (OC) has met to discuss how it will evolve into a full Board of Directors and has developed a strategy to bring principal data users and advocates from the User's Advisory Panel (UAP) into the Board which will become a Board of Directors in 2025. GWFO's Strategic Management

Committee (SMC), which reports to the OC, has been expanded to more closely reflect the major institutions contributing observatories to GWFO. GWFO has implemented, populated and developed terms of reference for the UAP to advise the SMC.

Physical and human resources are now tracked and managed centrally by the SMC through reporting by and direct exchange with the site managers and partner institutions. Operational procedures and policies have been developed and the SMC ensures compliance with these. The services offered by GWFO are now fully described on the website which provides a central point of access to data, fee-for-service and the data management system.

2. The facility needs to develop a strategic plan that defines the facility's vision and mission through a formal stakeholder consultation process.

GWFO has developed a vision and mission statement and supporting strategic plan. We have extensively consulted with users, now formalized through the UAP which provides advice and direction on these issues and on implementation of the strategic plan.

3. The facility needs to evolve its data management and data access policy to better define and justify embargo decisions and to eventually achieve open-access data availability through a centralized data platform. (Experts recommend that data should be owned by facility.)

The GWFO data management and access policy reflects CFI principles of open access, centralized metadata, and long-term, reliable preservation on GWFO Operational Data. Centralized metadata and access are provided via GWFNet. There are no embargos of GWFO generated operational data. Use of GWFO facility under fee-for-service arrangements not supported by our CFI funding may involve short term embargoes, to be negotiated with the paying entity. Data is managed by, but not owned by GWFO; its partner institutions govern access and use under their own IP regulations and subject to our central GWFO data policy. All partner institutions have agreed that GWFO will manage and openly share their data.

Appendix 1: Facility overview (maximum 3 pages)

After submitting the first annual report, do not update this section unless there are changes. Changes should be identified and explained.

1. **Provide a brief overview of the facility, including the facility's mission or vision statements. Include a link to the facility's website.**

Global Water Futures Observatories (GWFO) is Canada's premier national university-operated scientific freshwater observation network. With funding support, in part, through the Canada Foundation for Innovation (CFI) and its Major Sciences Initiative (MSI), GWFO operates 64 instrumented river basins, lakes, streams, and wetlands, 15 deployable measurement systems, and 18 state-of-the-art water laboratories. These monitor Canada's drainage basins and aquatic systems in fine detail at local scales across a vast portion of Canada, spanning many of the provinces and territories, and major river basins including the Yukon, Mackenzie, Saskatchewan–Nelson, and Great Lakes–St. Lawrence.

Our Vision: To operate a national water observatory consisting of a network of instrumented water observing sites, supported by deployable observing systems and major laboratories, that provides open access water data and the necessary infrastructure to collect supplementary data, which informs the development and testing of water prediction models, monitors changes in water sources, underpins diagnosis of risks to water security and helps design solutions to ensure the long-term sustainability of Canadian water resources.

Principles of Operation:

- provide unique water data of interest to characterizing and monitoring the conditions of Canadian river basins
- contribute to a critical baseline of freshwater data to the benefit of multiple users
- support the data collection from, and analysis of water from the network of instrumented freshwater observing sites
- adhere to the principles of open access

Website: <https://gwfo.ca/>

2. **Describe how the facility approaches strategic planning. Provide a link to the facility's strategic plan.**

GWFO has been developed and operates strategically as a pan-Canadian, solutions-oriented network of world-class freshwater observation sites and laboratories with an emphasis on big data for water and water solutions that interfaces tightly with its users. The network works as a collective towards overarching objectives and approaches for data collection, management, and sharing, while the individual facilities that make up GWFO are managed on a day-to-day basis by faculty and staff at the partner institutions. Strategic planning for operations and activities is done by the Strategic Management Committee (SMC) and the Operations Team (all facility and site leads along with technical and data management staff), supported by the GWFO secretariat. The strategic plan included with the application to CFI-MSI can be downloaded here: https://gwfo.ca/documents/gwfo_strategic_plan.pdf.

3. **Provide an overview of the facility's governance and management structures, including their functions, the frequency of meetings and a list of members. Use charts or images where needed.**

The governance and management structure for GWFO has evolved from that of GWF. The management plan included with the application to CFI-MSI can be downloaded here:

https://gwfo.ca/documents/gwfo_management_plan.pdf. In essence, GWFO is managed by a Strategic Management Committee (SMC; meeting bi-monthly), chaired and led by the Director and supported by the Secretariat. It is overseen by the Oversight Committee (transitioning to a Board of Directors; meeting

quarterly) and receives operational and planning guidance from the User Advisory Panel. The Operations Team (meeting several times a year) is responsible for the day-to-day operations of the facilities and instrumented sites and receives direction from the SMC. The GWFO website provides an up-to-date listing of these committees and personnel, along with their roles: <https://gwfo.ca/about/management-and-advisory-committees.php> and <https://gwfo.ca/about/staff-and-personnel.php>.

4. Outline any major infrastructure upgrades or additions planned for the facility aimed at maintaining or improving its international competitiveness.

There are no current plans for major upgrades or additions, with the exception of the proposed expansion of the network to include sites operated by other universities (see Part A, question 1—Further Expansion of the Network).

5. Describe the facility's risk assessment and mitigation strategy. Include reference to the facility's key risks.

The SMC identifies risks that have direct impact on GWFO operations and maintenance and is managing them on a proactive and case-by-case basis, including:

1. Environment Risks - Loss of instruments in extreme weather: Located at remote locations that experience extreme conditions, GWFO instruments are often subjected to harsh weather and events that make them non-functional or can impart irreversible damage. These instruments are not insured and replacement comes from operational funds and user-fee or in rare cases of large-scale loss, university self-insurance.
2. Technical Personnel - Work in extreme climate, in the North and large lakes: GWFO technical personnel require extensive wilderness safety, technical, programming and first aid training and knowledge of geography to function and maintain instruments at remote locations, (e.g. mountain and glacier locations, large water bodies,). Training of personnel is time intensive, and personnel are difficult to replace.
3. Financial Risk: GWFO has implemented a cost-recovery user fee system and is pursuing major funding opportunities with the Federal and Provincial agencies to sustain long-term operations.
4. Reputational Risk: Without GWFO, Canada will be unable to sustain historical observations and data critical to understanding, diagnosing and predicting changing water, terrestrial processes and climate. Moreover, Canada may lose its status as a global leader in the water sciences, and its growing reputation as an international example for implementing science driven water management and policy.
5. Interruption Risk: Without proper technical support and funding, important data will be lost and will need significant efforts to return these sites back to operational status. Some sites could not be recovered after a long interruption (e.g. one year)

6. Describe the facility's decommissioning plans.

GWFO intends to keep its observing sites and laboratories operating in the future. Observations started at some of these sites in the 1960s and their value for environmental monitoring and documenting the impacts of climate change and development on water grow with time. GWFO observing sites can in general be decommissioned by removing instruments and towers. Since these sites have minimal environmental impact, removal and clean up can be accomplished by two technicians in one day per site. Should any of the sites need to be shut down, this can be accomplished within the existing budget. Deployable monitoring systems have no decommissioning costs. The major laboratories have minimal decommissioning costs as they typically occupy part of one room at a university campus or with a collaborating government (Whitehorse, Yellowknife). Removal and cleanup of these rooms can be accomplished within two days per facility for a team of four technicians. Should any of the major laboratories need to be shut down, this can be accomplished within the existing budget.

Appendix 2: Additional information (optional)

- 1. List of select publications enabled by the facility in the past year (maximum two pages). Any citation style may be used.**
- 2. List of select awards or recognitions received by the facility or facility staff in the past year (maximum two pages).**
- 3. List of select conference presentations given by the facility or facility staff in the past year (maximum two pages).**

Appendix 3: Annual reports' external review process

Oversight activities based on annual reports	Risk level 1	Risk level 2	Risk level 3	Risk level 4
Written external review	X			
Expert committee review		X	X (includes meeting with facility reps)	
Standing expert committee review				X (includes meeting with facility reps)
Site visit			X (once during funding period)	X
Review frequency	Once during funding period	Once during funding period	Once during funding period	Annual meetings
Annual reports (ARs) provided for review	All available ARs prior to review date	All available ARs prior to review date	All available ARs prior to review date	Provided on annual basis