Environment and
Climate Change Canada

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National Freshwater Data Engagement Workshop: Towards a Canada Water Agency

March 8 & 12, 2021

Report prepared for:
Environment and Climate Change Canada

Canada

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EXECUTIVE SUMMARY

Environment and Climate Change Canada hosted the virtual National Freshwater Data Engagement Workshop on March 8 and 12, 2021 as an extension of the 'Toward the Creation of a Canada Water Agency' Discussion Paper initiative, focusing on the freshwater data challenges and opportunities to support this new agency.

Over 110 people attended the workshop with representatives from all 10 Provinces and 3 Territories (PTs), 12 Indigenous Groups, 24 Non-government Organizations (NGOs), 13 academics, and 4 other federal departments. The two-day event included presentations from freshwater experts and facilitated break-out groups on the status of freshwater data and its availability, perspectives from Indigenous Groups and non-governmental organizations and a proposed National Freshwater Data Management Strategy.

Participants spoke about their data access challenges and provided meaningful insights on how a Canada Water Agency could play a constructive role about freshwater data dissemination, in order to inform decision-making, impact policies, and guide best practices pertaining to better freshwater management across the country. Specifically, the participants noted the following:

Status of Water Data and Accessibility

- A wealth of data exists inside and outside the federal government, including from Indigenous Groups and PTs, municipalities, community-based monitoring (NGOs), and researchers.

- Accessing and using data is challenging because there is a lack of a standardized approach to collecting, managing, and sharing data.

- A number of government and non-government data platforms exist that could be leveraged, therefore we should not "re-invent the wheel".

- There is a need to better understand both data providers' and data users' needs with respect to data dissemination processes.

- There is support for a national data strategy in the areas of data collection, accessibility standards and the sharing of best practices.

Potential Roles of CWA related to Data

- Facilitate national collaboration through improved communication, coordination and connecting to promote trust and sharing.

- Coordinate development of national strategy to establish standards for data collection guidelines, tools, and accessibility/interoperability.

- A national freshwater data strategy and actions must support the aspirations of Indigenous people to be in control of their own freshwater management decisions.

- Consideration of funding dynamic data hub ("internet of water") to improve access to data from a single window.

- Provide leadership role on education with respect to freshwater by sharing lessons learned, new technologies, coordinate training.

- Consider increased support for community-based monitoring needs to properly operate and expand according to needs.

- Be sufficiently funded internally to coordinate, guide, and educate data providers and consumers and should have financial support available to assist less well funded groups to implement methodologies and best practices.

ACRONYMS

AAFC	Agriculture and Agri-Food Canada
API	Application Programming Interface
BC	British Columbia
CABIN	Canadian Aquatic Biomonitoring Network
CAPE	Canadian Association of Physicians for the Environment
CBWM	Community-Based Water Monitoring
CCCS	Canadian Centre for Cyber Security
CCME	Canadian Council of Ministers of the Environment
CESI	Community Engaged Scholarship Institute
CIRNAC	Crown Indigenous Relations and Northern Affairs Canada
CODATA	Committee on Data of the International Science Council
CA	Conservation Authority (Ontario)
CWA	Canada Water Agency
DFO	Fisheries and Oceans Canada
DOI	Digital Object Identifier
DRIPA	Declaration on the Rights of Indigenous Peoples Act
ECCC	Environment and Climate Change Canada
EPA	Environmental Protection Agency (United States)
FAIR	Findability, Accessibility, Interoperability, Reusability
FNIGC	First Nations Information Governance Centre
FRDR	Federated Research Data Repository
GIS	Geographic Information System
GoC	Government of Canada
GWF	Global Water Futures
IISD	International Institute for Sustainable Development
IHO	International Hydrographic Organization
ISO	International Organization for Standardization
NGO	Non-government organization
NRCan	Natural Resources Canada
OCAP®	Refers to the First Nations principles of ownership, control, access and possession of data
OGC	Open Geospatial Consortium
PGMN	Provincial Groundwater Monitoring Network (Ontario)
PTs	Provinces and Territories
StatCan	Statistics Canada
TBS	Treasury Board of Canada Secretariat
UN	United Nations
US EPA	United States Environmental Protection Agency
W3C	World Wide Web Consortium
WMO	World Meteorological Organization
WQX	Water Quality Exchange (US EPA)
WSA	Water Security Agency (Saskatchewan)
WWF	World Wildlife Fund

INTRODUCTION

CONTEXT

The Government of Canada (GoC) has committed to establishing a Canada Water Agency (CWA) to partner with provinces, territories, Indigenous communities, local authorities, scientists, and others with the goal of better managing freshwater in Canada. Environment and Climate Change Canada (ECCC), along with Agriculture and Agri-Food Canada (AAFC), have gathered and compiled information into a report, ranging from national to regional freshwater prospects, such as Water Governance, Indigenous Water Needs, the Canada Water Act, Climate Change, and Technology. Two key topics covered in this initiative are Freshwater Science and Data.

There is a wealth of scientific water-related expertise within Canada's universities and governments (Indigenous, federal, provincial/territorial, etc.) as well as at the community level. Intergovernmental agreements and other collaborative environmental monitoring frameworks provide reliable sources of freshwater data and information to scientists, water managers and policymakers. However, early feedback received from Canadians to date through the CWA engagement process indicate a need for expanded coordination of freshwater data collection activities at a national level.

To inform the data component of a CWA, the GoC is currently setting in motion a national initiative to compile a catalogue of available freshwater data sources across Canada. As a first step, four interdepartmental working groups are currently carrying out an inventory of freshwater data sources originating from within federal programs. The four groups are focusing on Water Quantity, Water Demand and Use, Aquatic Ecosystems, and Water Quality, respectively. A consultant has been hired to conduct a similar initiative, focusing on provincial, territorial, and other (non-federal) sources of freshwater data.

A fifth working group has been tasked with producing an overview of GoC's policies and directives regarding federal data governance, dissemination, and release of freshwater data. As part of their mandate, this working group will provide recommendations for standards that would meet federal needs for water data sharing and will propose next steps to develop data dissemination solutions. Preliminary observations and potential solutions, along with the status of the freshwater data inventory initiatives, were presented at the workshop to engage participants in a longer-term collaborative effort towards a National Data Strategy.

The 'Toward the Creation of a Canada Water Agency' Discussion Paper offers information on each of the above-mentioned freshwater prospects to initiate public engagement. Engagement on a CWA provides an opportunity to further convene and mobilize freshwater science, policy, and data sources to guide solutions to Canada's most pressing national and regional freshwater challenges. Independent of a CWA mandate, there is an expectation that freshwater data will play an essential role, as a key basic ingredient of science and policy that will support informed decision-making and actions within the CWA.

INDIGENOUS PEOPLES AND FRESHWATER MANAGEMENT[1]

The Government of Canada wishes to develop a comprehensive understanding of the various freshwater interests of First Nations, Métis, and Inuit to better inform the creation of the CWA. It is important to advance this conversation in order to strengthen relations, honour agreements and respect Indigenous rights, interests, knowledge systems, and cultures.

Fresh water is often sacred and at the centre of all life for Indigenous peoples. While all nations and communities are different, for many, water permeates every aspect of existence. Waterways have always been used for travel and navigation—both within territories and as a means of trade with other Indigenous groups or settlers. Water crossings served as meeting places, residences, and centres of trade for Indigenous peoples long before the arrival of European settlers.

First Nations, Métis, and Inuit are affected by climate change, pollution, hydrological and resource development, and other factors that negatively affect fresh water and freshwater species, such as fish, ducks, cattail, willow, muskrat, otters, and moose, to name a few. Many Indigenous peoples have stated that freshwater governance cannot be separated from decisions related to health and well-being, environment, or economy.

The Government of Canada recognizes that, for various reasons, Indigenous peoples in Canada have mixed and often limited opportunities to play a meaningful role in freshwater governance. The commitment to create a new CWA provides an opportunity for constructive dialogue between the federal government and Indigenous peoples on freshwater issues.

PURPOSE

On March 8 and 12, 2021, ECCC hosted a virtual workshop on Freshwater Data Engagement in Canada as a first step towards a Freshwater Data Strategy as part of the creation of the Canada Water Agency.

The GoC's Discussion Paper entitled 'Toward the Creation of a Canada Water Agency' presents key issues for consideration in the GoC's approach to creating the CWA. Freshwater data and information were identified as being 'paramount to supporting evidence-based decision-making' and therefore, a crucial element in the establishment of a CWA.

In the Discussion Paper's chapter on Freshwater Data, key opportunities put forward to support this area of interest include:

1) Reaching agreement with provinces, territories, Indigenous peoples and others on a National Data Management Strategy;

2) Implement a Freshwater Data Discovery Strategy;

3) Support decision-making and other freshwater management priorities; and

4) Work with Indigenous peoples to share freshwater data while respecting Indigenous rights, interests, knowledge systems and cultures.

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[1] Excerpts from 'Toward the Creation of a Canada Water Agency Discussion Paper, Section 3.4

The **National Freshwater Data Engagement Workshop: Towards a Canada Water Agency** is an extension of the CWA Discussion Paper initiative as it focused on gathering input to inform a Canada Water Agency on a national freshwater data management strategy.

OPENING REMARKS

OPENING PRAYER

As the workshop was hosted by individuals located on the unceded territory of the Algonquin Anishnaabeg, Elder Verna McGregor from the Algonquin community of Kitigan Zibi, commenced the workshop by highlighting the importance of water to Indigenous peoples.

Elder McGregor spoke to the importance of the Ottawa-Gatineau region to the Algonquin people, as it is part of their traditional lands, and spoke to the significance of Ottawa's location, at the confluence of the rivers coming together from four directions, like the Medicine Wheel.

Elder McGregor explained the importance of the Medicine Wheel, how it symbolizes the four directions, the four seasons, and the need for balance between our mental, physical, emotional, and spiritual selves. Balance is central to the Medicine Wheel.

Concerning water, Elder McGregor spoke to the role of women in being "the Keepers of the Water" and their connection to water by their bringing new life. For the Canada Water Agency, undertaking a Gender Based Analysis will be important, and future studies must involve water and the impacts on women and their reproduction, and on future generations.

An Algonquin prayer was then given.

KEYNOTE ADDRESS

Mr. **Michael Goffin** (Regional Director General, Water Policy ECCC) provided a keynote speech, summarized below.

Mr. Goffin recognized the importance that the GoC places on freshwater for both our economy and health and its commitment to creating a CWA to keep our water safe, clean, and well managed. He highlighted how engagement on a CWA provides an opportunity to further convene and mobilize freshwater data and knowledge that effectively inform decision-making. Mr. Goffin emphasized that the Agency will not have a regulatory focus, nor will it encroach on existing capacities or jurisdictions related to freshwater across Canada. Rather, as he pointed out, it will be designed to be more collaborative and bring added value to existing activities.

Mr. Goffin reminded the workshop attendees that the Government has launched a broader public engagement process for Canadians to share feedback regarding freshwater, following the release of the Discussion Paper in December 2020. He then pointed to the fact that data is a key topic that is highlighted in the Discussion Paper and stressed the need to put more thought into including Indigenous knowledge with Western science to have a more collaborative approach and respectful discussions with Indigenous peoples on an ongoing basis.

The aim of the two-day 'National Freshwater Data Engagement Workshop: Towards a Canada Water Agency' event was for a select group of Canadian freshwater experts, (i.e., freshwater data users, creators, providers, and owners) to offer input and recommendations regarding the role of a CWA in enhancing freshwater data availability and dissemination by promoting dialogue pertaining to specific discussion questions. The workshop was split into two days, where each day had a particular theme and focus.

Day 1: Status of Freshwater Data Availability in Canada

Day 1 of this workshop focused on providing an overview of federal freshwater data and the challenges related to accessing up to date information on Canadian freshwater data sources. Panelists first provided a snapshot of the current situation with respect to Water Quantity, Water Demand and Use, Aquatic Ecosystems, and Water Quality. These presentations were followed by a breakout session that consisted of two groups of ~10 participants for each topic previously mentioned. The breakout session allowed all participants to share their perspectives regarding freshwater data access and dissemination challenges and opportunities.

These are the questions that were discussed in small groups on Day 1:

1) Do you have datasets that you could contribute to a national inventory?
2) Do you feel you have access to the freshwater data you need?
3) What role could the Canada Water Agency play to support access to freshwater data?

Day 2: Data Dissemination Challenges and Opportunities

Day 2 began with a summary of what was shared on Day 1. Day 2 focused on the current options to address freshwater data challenges related to data discoverability and access while highlighting some principles that could be part of a National Freshwater Data Management Strategy. This included some reactions from an expert panel on data dissemination challenges and opportunities. Panelist presentations were followed by a breakout session which was structured the same as Day 1.

These are the questions that were discussed in small groups on Day 2:

1) What vision do you see as appropriate for the Canada Water Agency for managing freshwater data with the outcome that Canadians are able to find and use all essential freshwater data.
2) Do we need a National Freshwater Data Management Strategy? If so, are these the key components and what are some considerations (Data Access, Policy, Metadata Data, Quality Data, Archiving Data, Dissemination, etc.)?
3) How do you see working with the Canada Water Agency on freshwater data?

This workshop featured two plenary sessions in which the following panelists presented on Freshwater Data Availability in Canada and Data Dissemination Challenges and Opportunities. The event also featured presentations on a Proposal for a National Freshwater Data Management Strategy and a Freshwater Data Environmental Scan Initiative. The following is a list of panelists and presenters for this event:

Day 1:

- Mr. **André Bouchard**, Program Manager, National Hydrological Services, ECCC;

- Mr. **Jeff Fritzsche**, Section Chief, Statistics Canada (StatCan);

- Ms. **Carolyn Bakelaar**, Regional GIS Coordinator, Director's Office, DFO; and

- Ms. **Caroline Girard**, Section Head, Water Quality Monitoring and Surveillance, ECCC.

Day 2:

- Ms. **Kristine Neglia**, Manager, OCAP® & Information Governance, First Nations Information Governance Centre;

- Ms. **Carolyn Dubois**, Executive Director, Water Programs, Gordon Foundation;

- Ms. **Janice L. Sharpe**, Senior Director, Federal Geospatial Platform, NRCan;

- Ms. **Sonia Trentin**, Data Manager, NRCan;

- Mr. **Jamie Smith**, Chief Data Officer and Chief Results and Delivery Officer, ECCC; and

- Ms. **Linda Lee**, Information Management Consultant, Systemscope Inc.

DAY 1

The goal for the first day of the National Freshwater Data Engagement Workshop was to stimulate discussions among freshwater data users, creators, providers, and owners on the topic of the current status of freshwater data availability in Canada. This included insights on a national inventory and how a CWA could enhance freshwater data access across the country.

PANEL PRESENTATIONS: STATUS OF FRESHWATER DATA AVAILABILITY IN CANADA

For Day 1, four federal freshwater experts were invited to speak during a panel session focused on the topic of federal freshwater data sources regarding four areas: Water Quantity, Water Demand and Use, Aquatic Ecosystems, and Water Quality. Each presentation featured a dashboard highlighting the number of data providers and federal data sets available, including the types of data, sources, and spatial distribution for each area.

The presented federal freshwater data is available at: https://open.canada.ca/en

MR. ANDRÉ BOUCHARD (WATER QUANTITY)

Mr. André Bouchard joined the Meteorological Service of Canada's Water Survey in 1997, where he managed several projects in the areas of hydrometric field technologies, network planning and management, hydrometric data production and management, hydrological data analysis and migration of water resources modelling systems to operations. Mr. Bouchard is currently Program Manager of the headquarters office of the National Hydrological Service that provides national support for hydrometric monitoring in the areas of field technologies, data production and management, data dissemination, standards, training, and quality management. The unit also includes two domestic water management board secretariats (Ottawa and Lake of the Woods) as well as a hydrological services unit.
Mr. Bouchard's background is in Water Resources Engineering, and he also has 8 years experience working in the water quality field between 1989 and 1997.

For Water Quantity, data types are related to the hydrological cycle and include:

- Hydrometric data;

- Lake ice mapping/monitoring;

- Hydrographic data;

- Bathymetric data (collected by sonar and/or LIDAR);

- Precipitation and Evaporation data;

- Snow and Water Equivalent data;

- Groundwater data;

- Climatology data;

- Wetland evaluation;

- Annual water supply data;

- Soil moisture data; and

- Water extent data (from remote sensing).

As of today, the federal government water quantity inventory holds 118 datasets from 8 different data providers. Data providers include ECCC (Water Survey of Canada and National Hydrological Service), DFO (Canadian Hydrographic Services), NRCan (Lands and Minerals, Canada Centre for Mapping and Earth Observation, and Canadian Forest Service), AAFC, StatCan, and Crown Indigenous Relations and Northern Affairs Canada (CIRNAC). Most of the data was collected from southern and central Canada.

The following is a list of challenges/opportunities for federal level 'Water Quantity' freshwater data:

- Larger datasets directly impact accessibility to data and some data is not yet published.

- Implementation of geomatics tools could enhance the usefulness of this data.

- There is mixed use of the Findability, Accessibility, Interoperability, Reusability (FAIR) principles.

- There are different purposes for Water Quantity data depending on scale (i.e., national, provincial, regional, and local).

- Water Quantity data types often need to be used together for a given purpose (e.g., agricultural purposes demand that data be drawn from soil moisture and hydrometric datasets).

MR. JEFF FRITZSCHE (WATER DEMAND AND USE)

Mr. Jeff Fritzsche has been the Assistant Director of the Environment Accounts and Statistics Program since 2019. Mr. Fritzsche began working in the environment statistics program as a geomatics analyst and has spent most of his career working on the development and production of various environmental surveys and environmental accounts. Currently, Jeff leads a program that develops and produces a variety of environmental statistics that include physical and monetary environmental accounts, environmental surveys and statistics related to government, industry and households and the integration of earth observation data and socioeconomic statistics using geomatics tools and platforms. Jeff holds an honours degree in Geography.

For Water Demand and Use, data is mainly represented in physical quantities from various water users, such as industry, households, various sectors of the economy, etc. Data types also include biological and chemical. In fact, at the federal level, Parks Canada is the only entity collecting biological and chemical data specifically related to their various programs.

As of today, the federal government Water Demand and Use inventory holds 47 datasets from 7 different data providers. Data providers include ECCC, AAFC, StatCan, and Parks Canada. Most of the data presented is collected from southeastern Canada. The number of datasets quoted here is an underrepresentation of all related Water Demand/Use datasets as many datasets from various jurisdictions (e.g., NRCan, DFO, Library and Archives Canada, etc.) still need to be incorporated into this federal freshwater data bank.

This inventory exercise on federal 'Water Demand and Use' data has revealed that more work is needed to define the term 'Water Demand'. Moreover, many datasets not related to or tagged as pertaining to 'Water Use' may be used to support derived variables to gain a clearer picture of the demand and use of this resource.

MS. CAROLYN BAKELAAR (AQUATIC ECOSYSTEMS)

Ms. Carolyn Bakelaar has been the Regional Geographic Information Systems (GIS) Coordinator for DFO for the past 11 years. Carolyn provides leadership and strategic planning in establishing innovative solutions using GIS technology. She is the technical lead for mapping Canada's Aquatic Species at Risk which communicates data through interactive web mapping. Carolyn is also engaged in implementing DFO's Data Strategy and is currently chair of the Data Stewardship, Metadata Working Group. Carolyn provided GIS support for research scientists in DFO's Great Lakes Laboratory for Fisheries and Aquatic Sciences for 16 years prior to her current position. Carolyn holds a Bachelor of Environmental Studies from the University of Waterloo with a major in Geography.

For Aquatic Ecosystems, data types were grouped into four distinct areas to make the scope more manageable. These include:

- Base layer data (including watersheds, ecozones, biozones, wetlands, land cover, and land drainage patterns);

- Biodiversity data (including all invertebrates, fish, birds, amphibians, beavers in species occurrences);

- Hydrology data (including coastal dynamics and processes, ice stream, and wetland hydrology); and

- Wetland data (including bog dynamics, wetland health, and wetland productivity).

As of today, the federal government's 'Aquatic Ecosystems' inventory holds 219 datasets from 8 different data providers. Data providers include ECCC, AAFC, Parks Canada, DFO, StatCan, NRCan, and provinces/territories (namely British Columbia, Alberta, Ontario, and Québec). The highest number of datasets are from southwestern Canada.

The following is a list of challenges and opportunities for federal 'Aquatic Ecosystems' freshwater data:

- Many federal water-related datasets are not specific to freshwater (i.e., marine datasets need to be excluded).

- There is a need to have a structured process to define what is a freshwater ecosystem (i.e., what to include in such a freshwater ecosystem scan and inventory).

- 'Aquatic Ecosystems' data, as presented here, may overlap with other data groups represented in this report (i.e., Water Quantity and Water Quality).

- 'Aquatic Ecosystems' data are often derived from multiple inputs.

- Resource limitations and constraints reduce the amount of published data for this area of freshwater knowledge.

MS. CAROLINE GIRARD (WATER QUALITY)

Ms. Caroline Girard is the Head of the National Coordination and Integration Section for the Water Quality Monitoring and Surveillance Division at Environment and Climate Change Canada. Her team supports water quality monitoring activities in the major freshwater basins and in shellfish areas across Canada. This support includes providing data management expertise, policy analysis, advice and

development, coordination of continuous program improvement initiatives. Throughout her career, Caroline has continuously aimed at integrating science-based decision-making in environmental management, for example when contributing to the Canada-Quebec Agreement on the Protection and Enhancement of the St. Lawrence, also known as the St. Lawrence Action Plan. She also acted as scientific liaison for the St. Lawrence communities and coordinated numerous concertation activities for the participatory water resource management of the ecosystem. Caroline holds a master's degree in aquatic biology as well as a master's degree in civil and environmental engineering.

For Water Quality, data types are dependent on federal legal obligations related to policy drivers, such as Water Management, Agriculture, Science, Drinking Water, and Climate Change, and include:

- Physical data;
- Chemical data;
- Bacteriological data;
- Toxicological data; and
- Indicator/Index data.

As of today, the federal government Water Quality inventory holds 270 datasets from 8 different data providers. Data providers include ECCC, AAFC, Health Canada, Parks Canada, StatCan, Canada Border Services Agency, Public Services and Procurement Canada, and Correctional Services Canada. ECCC is currently the largest provider, representing 80% of the Water Quality data presented here. The highest number of datasets come from two clusters, one in central Canada and the other in southeastern Canada.

This federal inventory exercise revealed opportunities to improve Water Quality data accessibility in Canada. Currently, the Canadian Water Quality datasets inventory is incomplete and needs contributions from other data providers (i.e., non-governmental organizations). Specifically, community-based water monitoring would significantly enhance the Water Quality data geographical coverage across the country. Also, Water Quality data availability in Canada would greatly benefit from a clear Water Governance Model in which innovative solutions for data management are key players in improving its accessibility.

SUMMARY OF FRESHWATER DATA MANAGEMENT CHALLENGES AND OPPORTUNITIES AT THE FEDERAL LEVEL

Although the freshwater data federal inventory exercise revealed specific struggles for the freshwater areas presented (i.e., Water Quantity, Water Demand and Use, Aquatic Ecosystems, and Water Quality), it also revealed several challenges and opportunities for Canadian freshwater data in general within the federal government realm, as detailed below:

- The current inventory could be enriched with input from other federal agencies and departments not included in this preliminary scan.

- Not all data in the Open Data Portal is up to date since preparing data holdings for publication on the portal is work intensive and departments are taking a phased approach.

- Authoritative datasets are published to Open Data.

- Metadata harmonization is needed to understand the scope, quality, purpose, or context of the datasets.

- Various data quality standards and verification processes exist across the country which leads to inconsistency in data quality.

- Many federal programs are often dependent on limited resources which may result in an as-needed ad hoc approach when managing data. This is compounded by the us of different data management systems. Moreover, some programs may not have even published their data onto the Open Data Portal as this is not a controlled process.

- Not all data are readily machine accessible or readable even though most programs follow the Findability, Accessibility, Interoperability, Reusability (FAIR) principles.

- The data publishing process is usually authorized by a Chief Information Officer (or similar process), and Quality Assurance and Quality Control processes are applied in various ways within the federal family.

- Water is a shared responsibility in Canada; thus, there are opportunities for improving collaboration and overall governance across provinces and territories.

BREAKOUT SESSION 1

All workshop attendees (including panelists) were assigned to smaller groups (2 breakout groups per discussion area with ~10 participants per group) to have more focused and significant discussions on three questions related to the availability and accessibility of Canadian freshwater data.

The Day 1 Breakout Session allowed the identification among workshop participants of more than 18 data providers holding ~160 datasets related to freshwater. Overall, participants expressed a lack of knowledge of existing Canadian freshwater data and datasets and a need to improve discoverability of this information across the country. Moreover, discussions captured a desire for the CWA to improve collaboration, more funding for dynamic data banks, and leveraging existing platforms to link datasets into an "internet of water".

The following subsections summarize the key points that were made by participants for each question that was discussed during the Day 1 Breakout Session. General questions and comments were also provided by participants during these discussions.

Q1: DO YOU HAVE DATASETS THAT YOU COULD CONTRIBUTE TO A NATIONAL INVENTORY?

Water Quantity

- The Mikisew Cree First Nation worked on the Wood Buffalo National Park Action Plan which created a data hub relevant to this effort (including community-based ice monitoring, navigation hazards, etc.).

- Alberta Energy Regulator (via the Alberta Geological Survey) has data on groundwater availability for non-saline aquifer that are watershed-based available at: https://ags.aer.ca/

- Municipal governments have a wealth of data.

- The New Brunswick Department of Environment Hydrology Centre has data on flow and flood for the St-John River basin through water resource reporting. This includes information on snow depth/water equivalent, visual ice observations, and citizen science through the project on environment evaluation and flow monitoring.

- DataStream (and The Gordon Foundation) has 132 water quality datasets, mostly Community-Based Monitoring with planned expansion to disseminate groundwater data in the future.

- Regarding citizen science in Alberta, there is at least one regional program for groundwater: http://rockyview.sensorup.com. These programs were led by universities in partnership with communities and a funding agency. Water level recordings are available at daily to weekly frequencies.

- The Ontario Provincial Groundwater Monitoring Network (PGMN) has data on vulnerable aquifers, stressors, and baseline monitoring that are open data.

- Alberta Environment Monitoring program has data on ~350 wells, hourly water levels (some are daily) that are available on 2-3 portals, but these are not compliant with international standards.

- There is data on the Yukon Watershed (Located Anchorage) based on observations performed by Indigenous peoples that include information on water quality, snow depth/water equivalent, isotopes, ice thickness, water flow. (Note: We did not see snowpack and snow melt data in the presentations. Would like that in relation to snow data for run off.
  Response from ECCC: The Water Quantity presentation listed 'Snow (snow water equivalent)' as one of the variables included in the inventory.

- Provincial data in flood forecasting centres use snowpack data for flood modelling. The measurements are not formally archived as they are used internally only. Remote sensing data is also now being used for snowpack measurements.

- Conservation authorities collect water quantity data. These include data grabs for which spreadsheets are available for data collected for a given period. Many Conservation Authorities have general water quantity data on their websites.

- ECCC has many national water quantity datasets.

- Conservation Ontario is trying to bring all the water quality and quantity on to one website. Moreover, The Gordon Foundation is looking to integrate water quality data for Conservation Ontario.

Water Demand and Use

- CWA could help with facilitating the collection of water use data from industry and local users in real-time.

- Best management practices for small communities facing water management issues (including qualitative & quantitative data) at: https://www.saskbmp.com/

- More opportunities to recognize and engage Indigenous data collection and sharing activities within the governance of Indigenous Nations.

- Groundwater licensing data work.

- The Government of British Columbia uses data from regional governments.

- Use and demand is typically framed in relation to humans, thus we must also ensure that fauna and flora are considered (e.g., minimum flows for aquatic life, for instance).

- Water availability is linked to water inputs and quality. So, data on climatic factors like precipitation/evaporation that are beyond consumption need to be considered (e.g., meteorological services, snowpack, water budget (including different forms, mapped through different processes, etc.).

- Must include snow data, which is a big component for provinces. Moreover, need to include information on glaciers and what is being done at the national level.

- Saskatchewan groundwater data is public and available on request, but not available by default on website due to privacy concerns.

- The Government of Nunavut is in the process of developing a Water Resources Sector. Currently, Crown Indigenous Relations and Northern Affairs are responsible for water management. The Federal and territorial governments are currently negotiating the devolution of these responsibilities.

Aquatic Ecosystems

- The University of Manitoba has a lot of data that needs to be standardized/organized, and digitized. It has a bigger program on Arctic research data, which translates into freshwater data.

- The Canadian Water Resources Association does not hold datasets but represents data users (500-800 members/year which includes academics and practitioners in the water resources industry).

- The Columbia Basin Water Hub is bringing data online next week.

- DataStream has over 130 datasets that that follow international standards for metadata and observation level data.

- ECCC performs national coordination and implementation and Water Quality monitoring and surveillance for St. Lawrence and Atlantic Canada and requires access to data for water management purposes.
  (Note: ECCC has engaged with The Gordon Foundation to integrate their data into DataStream.)

- Data needs to be shared across Canada. Standardization and interoperability both have limitations, need to know where data is located, who to contact, and find ways to expand current data. There is also a need to automate this process.

Water Quality

- Territories are limited in human resources in comparison to provinces and will require more assistance to make the data available and useable.

- Database on phosphorus loads for Lake Winnipeg which is collected by citizens. Citizen science is a deliberate approach to be complementary to provincial and national platforms. The data is openly available on DataStream (to be easily accessible and shareable).

- Water Rangers has a community-based water modelling dataset which includes an app for data collection in the field through which all information is accessible online (and data is integrated in the DataStream platform). The group is also working with existing data structures and international WQX standards.

- NRCan Groundwater Network has datasets that are limited to the NRCan Geological Survey of Canada data and that is tapped into water networks across Canada that could be expanded for water quality data.

- DFO has specific ecological data but struggles with successfully designating resources for managing and communicating this information and navigating through the existing government infrastructure.

- Statistics Canada has surveys that include information on water quality (i.e., drinking water).

- Global Water Futures Program has researchers across Canada working on water quality and runs into difficulties when accessing data from different sources and in different formats. They publish data of all types and are engaged with DataStream as a standard (i.e., using their template) for storing the data. In this construct, the academics are both data users and providers.

- Canadian Wildlife Service manages wetlands database (includes data from academics and NGOs), related to wetland loss in Canada (based on ground-truth data, not remote sensing) in collaboration with NRCan to cover the country.

- ECCC has water quality monitoring data that has been collected since the 1960s which includes ~20 databases, yet it is still struggling due to lack of tools and infrastructure needed to streamline data. There is a need for additional resources to support the existing data management systems and for connecting them.

Q2: DO YOU FEEL YOU HAVE ACCESS TO THE FRESHWATER DATA YOU NEED?

Water Quantity

- There are significant gaps in data availability in the Athabasca Delta. Specialized monitoring is required.

- Water quantity data from sources other than federal data are hard to come by: provincial, municipal and from private corporations.

- There is a need for a more streamlined access to water quantity data, and a need for coordinating standards for this data.

- In Alberta there are many local-scale groundwater level and quality data collected for compliance purposes at regulated sites (e.g., mines, contaminated sites, etc.), that are not commonly reported to the government or are available only in paper form and not readily accessible to government or public data users. Also, soil moisture information does not include ground-truth data and snowpack data tends to be more accurate.

- Cree Nations are doing more environmental monitoring, mostly around harvest of import species and water quality, but little on water quantity. Having a central location and more working relationships with the various agencies and departments would be beneficial in water quantity data collection.

- The Water Office is a central repository for most hydrometric data in the country. There are stations across the country and all data is published with national hydrometric standards. Unfortunately, for other users such as an ecology issue, accessing data can be cumbersome if you are not familiar with how it is set up.

- Relationships and trust are needed to share data with and from Indigenous peoples.

- The frequency of data collection is also an important factor.

Water Demand and Use

- Agriculture amounts for ~1/3 of water consumption in Canada.

- Water use is generally not a large problem for the Yukon due to small populations and large water reserves. The use of water requires licenses and reporting on the amount used, yet compiled information over a large area is difficult to obtain.

- The definition of 'water use' may vary (e.g., recreational use vs diversion of creeks). There is a need to clearly define the term and measurements used.

- A lot of assets available at federal, provincial, and municipal levels with a challenge for pooling all data to provide a common view of the water cycle. There is a need for metadata of what is available. Metadata is usually not associated to the available data and the context is not easily recognized which is needed when accessing other jurisdictions' datasets.

- Context and methodologies need to be better documented along with data.

- Obstacles for accessing water data includes technology/computational capacity (i.e., accessing large datasets with bandwidth limits), poor discoverability, and non-standard formats/low interoperability. There is a need for standardization.

- We need to engage communities on specific issues or questions. For example, Vancouver sought data on heritage trees and asked citizen scientists to collect three metrics around trees.

- Municipally led monitoring programs include beach-swimmable areas that are monitored 8 weeks a year, yet locations are typically available for 16 weeks.

Aquatic Ecosystems

- For small NGOs and community-based water monitoring programs, it is hard to access data. There is a need for a platform to access all available data.

- For Lake Winnipeg Foundation community-based monitoring of phosphorus hot spots, the data is already outdated by the time it is made available. The timing of data availability is crucial.

- For the Mackenzie River Basin Board, the idea of using data in a holistic and basin-wide manner is starting to be adopted where consistency, longevity, and place-based monitoring are important. They are also trying to include long-term datasets and trends with smaller-scale datasets.

- University of Manitoba has studied community-based monitoring and found that there is often an emphasis on Western science, but there is a need to also include Indigenous knowledge. This raises the question of how to include Indigenous data.

- Communities usually collect only water quality/chemistry data. There is a need for engagement on how Indigenous knowledge should be documented and what should be measured.

- New Brunswick's Department of Environment has some datasets at the Community Engaged Scholarship Institute (CESI), the Canadian Aquatic Biomonitoring Network (CABIN), and the Atlantic DataStream. Some of the available historical data were generated as part of government-sponsored monitoring programs while other data was community collected. There is a need to know who is monitoring what and where, and how to use and store data effectively.

- At ECCC, water quantity data is made available in real-time (i.e., water survey), but water quality data is published within 30 days of collection. Open Canada Data Portal is not ideal for searching.

Water Quality

- DataStream is a good platform for water quality data. Evaluation of this structure is warranted to see if it could be expanded for other data. For example, the Federated Research Data Repository (FRDR) works by pulling data from existing open data sources.

- Need for a data inventory that encourages discoverability by pulling metadata from existing databases. Also, we need to identify the best existing solutions and connect them.

- NRCan Groundwater Information Network has been making data interoperable and has been involved in the development of data standards used in different countries (including the discoverability of data, collaboration with the US to make all water data available [gin.gw-info.net/]) that is underpinned by a set of standards.

- 'The internet of water' as an international example for connecting organizations together on water data and information.

- Data users are not always aware of where datasets exist and need to be informed properly.

- Understanding the data can be challenging. The narrative of what the data means is very important. Moreover, there are huge data gaps that need to be address and how data is being shared needs to be improved (e.g., structured dataset that can be accessed in real-time).

- What are the fundamental factors that we need information on?

- Need more visibility and transparency over water data in Canada.

- Releasing data years afterwards can be problematic for responding to issues and make decisions in a timely manner. Lag from data collection, analysis and then release of data causes issues with respect to data being able to have a meaningful impact.

- CWA indicators/metrics of success need to be beyond the number of datasets and answer the following questions to gauge the impact of the data: What does this data help us do? Did the data help you accomplish your work?

- Intellectual property issues for publication of data based on the traditional academic research process.

- There is a need for knowledge mobilization mechanisms and platform. Moreover, publication of datasets can be cumbersome and should be simplified.
- There is a huge need for data on the North and Arctic region.

Q3: WHAT ROLE COULD THE CANADA WATER AGENCY PLAY TO SUPPORT ACCESS TO FRESHWATER DATA?

Water Quantity

- A Water Survey of Canada for better national coverage.
- CWA could set data standards and national perspectives.
- Identify gaps to be more proactive toward data producers.
- CWA could collect and distribute data to the public while specifying the quality of data.
- Environment Ontario (Ministry of the Environment, Conservation and Parks) has a challenge when it comes to sharing historical data (i.e., a lot of work for large datasets, paper formats, old databases, etc.).
- Having metadata and key words to enforce data standards on what the fields should be and what should be included, etc. People collect things a bit differently.
- Provide best practices for data collection and metadata, including guidance on the most helpful ways to provide data.
- Leverage new technologies for remote sensing data (e.g., winter forecasting, measurement of ice surface, texture, etc.).
- A data repository for analysing long-term trends (e.g., flooding, droughts, etc.).
- Give equal importance to ground water – quantity and quality.
- There is a lack of resources at the Conservation Authority level (i.e., inconsistent funding). This affects the quality of data and produces data gaps.
- Use the Canadian Energy Data Canadian Centre for Energy Information as an example:
  https://energy-information.canada.ca/en
  It has good metadata and collaboration between federal, provincial, and municipal partners. CWA could play a collaborative role for partners and for data inventories.

Water Demand and Use

- For Lake Winnipeg access to data is slow and there are data trust issues (i.e., requires a lot of negotiation). Manitoba Hydro has a huge influence through watershed. It is a Crown Corporation that collects its own data (provincial data) but those have been not transparent.

- Sometimes the issue of getting data is about not having enough resources to get the data.

- Mechanisms for recognition of Indigenous governance and Indigenous knowledge.

- Providing national support for nomenclature and data standardization (e.g., data analytics and methodologies for analysis that can be reproduced across the country). This includes the fostering and establishment of communities of practice.

- Coordination between provinces and territories to improve accessibility of data. For example, paralleling NRCan's Groundwater Information network.

- Dataset is provided to NRCan, and they post it to their platform where it is available. CWA could mimic this.

- A centralized and dynamic data bank of what is available to overcome technological, format, and organizational barriers across Canada.

Aquatic Ecosystems

- CWA (with other organizations) could develop a portal to create linkages to connect existing databases.

- Changing the culture from data ownership to openly sharing data.

- Increasing interoperability by developing dictionaries that facilitate interoperability, instead of imposing standards, mapping from existing ways towards something that is standardized and including historic data to gain insight on long-term trends.

- More easily include smaller organization data.

- Support on quality of data and ways to know if enough metadata is available to understand how it was collected (i.e., a "Known Quality" approach).

- There are many types of data being collected by groups across Canada. There is a need for a standard definition of data (i.e., how we are defining data, and being specific but also conscious that there are other types of data from other systems of knowledge).

- CWA has a responsibility/obligation to preserve and protect long-term monitoring programs.

- CWA could play a role similar to that of the Great Lakes Restoration Initiative plays in the United States, by providing additional funding to organizations to support their collection of data and long-term storage/maintenance of data.

- CWA could raise awareness of the data-related activities that are ongoing.

- We need to develop a research agenda that would support the longevity of the CWA, to ensure that the CWA is mandated even if there is a change in government.

Water Quality

- Build on what is already out there and increase connectivity across networks.

- Play a role in discoverability (i.e., adding a discoverability layer) and identifying the successful systems to use across Canada.

- Identify data gaps and needs (e.g., Arctic region water quality).

- Aiming for a broad scope of coverage and time, including historical data.

- Coordination and support for the many data holders/providers to mobilize their information. For instance, smaller organizations have data and are willing to share it but often do not know how or where to do so.

- Focus on the data users' needs and the data user experience. Providing training, guidelines, and tools.

- Foster collaboration of data between traditional boundaries: federal, provincial, territorial, Indigenous, non-government, etc., to include all perspectives and all forms of water quality data. For example, Indigenous-based videos are very moving and impactful for public awareness.

- Use the principles of Communicating, Connecting, and Collaborating. Information is key to shed light on what the data means for all Canadians at all levels.

GENERAL QUESTIONS/COMMENTS FROM BREAKOUT SESSION 1

Defining a CWA Mandate and Vision:

- How can we ensure that freshwater data directly impacts policy? What role could the Canada Water Agency play to support access to freshwater data?

- Should our work focus on better defining and integrating water data for the federal government, or should it be to highlight a data management strategy that the Canadian Water Agency could adopt to achieve better data awareness and integration at all levels?

- Do the federal agencies represented here collect or use water quality data (for surface water or groundwater) that is collected by non-government sources, such as (but not limited to) universities, non-profit professional agencies, community associations, etc.?

- Need for a 10-year vision that includes Canada-wide freshwater data acquisition and management to provide a better foundation for others to build around this and influence others to think and plan longer-term as well (e.g., potential collaborators, etc.).

- A national inventory of freshwater data with a distributed approach by recruiting organizations with regional/local knowledge and relationships with those generating freshwater data.

- Emphasis is needed on the Geospatial aspects of freshwater data generation and management regarding many aspects of freshwater monitoring planning and data use (e.g., data searches, analyses, interpretation, reporting, etc.).

- Emphasis is also needed on technologies related to freshwater data generation and use. Growth and use of new technologies for freshwater data generation and management is accelerating and could continue to do so with more financial and organizational support, especially in the context of translating innovations into actions.

- Need to focus on Education and Outreach to broaden participation in freshwater monitoring and management. There is Canada-wide growth of interest and involvement in water monitoring and its use in planning and decision-making on the part of Indigenous and other citizen led groups. Of key importance is providing existing monitoring groups and those with similar aspirations with knowledge and training. This could include the various aspects of the generation and use of freshwater monitoring data, and could be accomplished in multiple ways (e.g., CWA regional centres, partner governments, non-government groups, such as WWF, The Gordon Foundation, LLC, etc.). Subjects covered should span the "life cycle" of freshwater data (e.g., scientific methods, project planning, preparation and execution of field work, data management in all its forms, data analysis and interpretation, reporting, and use in planning and decision-making).

Engagement with Indigenous People:

- How do we envision involving hundreds of Aboriginal governments across Canada in data governance issues? How will Aboriginal governments be included in data governance and information management in the future?

- The First Nations Information Governance Centre (FNIGC)'s vision is that Each Nation achieves data sovereignty in line with their own world view: https://fnigc.ca/

- A participant from the Manitoba Metis Federation would like to stress the importance of a distinctions-based approach, meaning equal representation of Indigenous Nations.

- There are 88 Indigenous language groups in Canada and about 700 communities that align with these nations. The federal government could convene nations (language) groups in each province to discuss this. It would be aligned with BC's Declaration on the Rights of Indigenous Peoples Act (DRIPA). British Columbia is the most diverse province (34 nation groups and 200 communities). A national First Nations data strategy has been tabled with the federal government and needs to be funded. More information is available at: https://www2.gov.bc.ca/gov/content/governments/indigenous-people/new-relationship/united-nations-declaration-on-the-rights-of-indigenous-peoples

- Indigenous people belong to Nations (language, culture, etc.) and reside within communities in which governments are elected to represent the collective interests. There is a need to recognize these entities as governments of communities. For example, the Ktunaxa Nation did a lot of work to protect 'Jumbo Glacier.' There is also a need for connectivity among First Nations governments. Contact Gwen Phillips (gphillips@ktunaxa.org) for more information.

- Water quality on Federal First Nations Reserves and the human/environmental impacts of poor water quality are often in the news. Aboriginal Services Minister, Marc Miller, has noted that water data is needed to work on solutions, but that "data collection cannot be imposed on Aboriginal communities", yet the federal government is imposing data collection on First Nations people and communities. How can CWA address this issue?

Considerations for Groundwater/Aquifers in Canada:

- How can groundwater ecosystems and groundwater-dependent ecosystems be included (as groundwater is Canada's largest liquid freshwater resource, providing ecosystem services and being critical to the maintenance of many surface water ecosystems)?

- Does the current inventory include federal groundwater quality data? If so, what is the percentage distribution of surface water quality data vs. groundwater?

- Since most groundwater quality data is provincial, this could be an opportunity for Canadian Association of Physicians for the Environment (CAPE) to provide leadership and guidance on national standards, groundwater quality data availability and collaboration with Canadian provinces and territories.

- 80% of water quality data currently comes from ECCC. If provincial and territorial data sources were included, how would this percentage change?

Resources for Freshwater Data Management in Canada:

- The Lake Winnipeg Community-Based Water Monitoring Program data: https://datastream.org/dataset/f10bb610-63cc-46c1-81b1-74a6b0310655

- The FRDR offers a metadata search for datasets. https://www.frdr-dfdr.ca/repo/

DAY 2

The goal for the second day of the National Freshwater Data Engagement Workshop was to stimulate discussions among freshwater experts on the topic of freshwater data dissemination in Canada within the context of developing a National Freshwater Data Management Strategy.

PANEL PRESENTATIONS: DATA DISSEMINATION CHALLENGES AND OPPORTUNITIES

For Day 2 of the workshop, three freshwater data experts were invited to speak during a panel session focused on the topic of freshwater data dissemination challenges and opportunities in Canada.

The panel session was followed by a presentation on a proposal for a National Freshwater Data Management Strategy which includes aspects such as Data Access Policy, Metadata, Data Quality, Data Archive, and Data Dissemination.

MS. KRISTINE NEGLIA

Ms. Kristine Neglia is the Manager, OCAP® & Information Governance with the First Nations Information Governance Centre. Responsible for education and training activities, Kristine supports First Nations, Indigenous and non-Indigenous organizations increase their knowledge and skills related to OCAP®, Information Governance, and First Nations Data Sovereignty. A member of the Curve Lake First Nation in Ontario, Kristine has worked for Indigenous organizations at the local, provincial, and national levels, and is always excited to speak about the First Nations Principles of OCAP®.

The First Nations Information Governance Centre is an independent, apolitical, and technical non-profit organization operating with a special mandate from the Assembly of First Nations' Chiefs-in-Assembly (Resolution #48, December 2009)[2]. FNIGC became an independent, incorporated non-profit entity on April 22, 2010. But its history can be traced back to 1996, when the Assembly of First Nations formed a National Steering Committee to design a new national First Nations health survey in response to a decision from the Federal Government to exclude First Nations people living on reserve from three major population surveys[3]. FNIGC is responsible for a wide range of work, from research and planning to surveys, capacity development, education, and training[4].

The First Nations principles of OCAP® establish how First Nations' data and information will be collected, protected, used, or shared. Standing for ownership, control, access, and possession, OCAP® is a tool to support strong information governance on the path to First Nations data sovereignty. Given the diversity within and across Nations, the principles will be expressed and asserted in line with a Nation's respective world view, traditional knowledge, and protocols.

To learn more about the First Nation principles of OCAP®, there is a 7-module online course called the Fundamentals of OCAP® that provides insight on how these principles can be respected and observed in the work that you do. Please visit: https://fnigc.ca/ocap-training/take-the-course

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[2] https://fnigc.ca/?s=resolution+48
[3] https://fnigc.ca/about-fnigc/our-history/
[4] https://fnigc.ca/about-fnigc/our-impact/

MS. CAROLYN DUBOIS

Ms. Carolyn Dubois is Director of the Water Program at The Gordon Foundation where she works with partners across sectors in Canada's North. Her work focusses on improving freshwater stewardship through community engagement and informed decision-making. Carolyn led the development of the Mackenzie DataStream – an online system that provides access to water quality information. She offered her standpoint having worked with groups across Canada and across sectors that are working with freshwater data and trying to access it online.
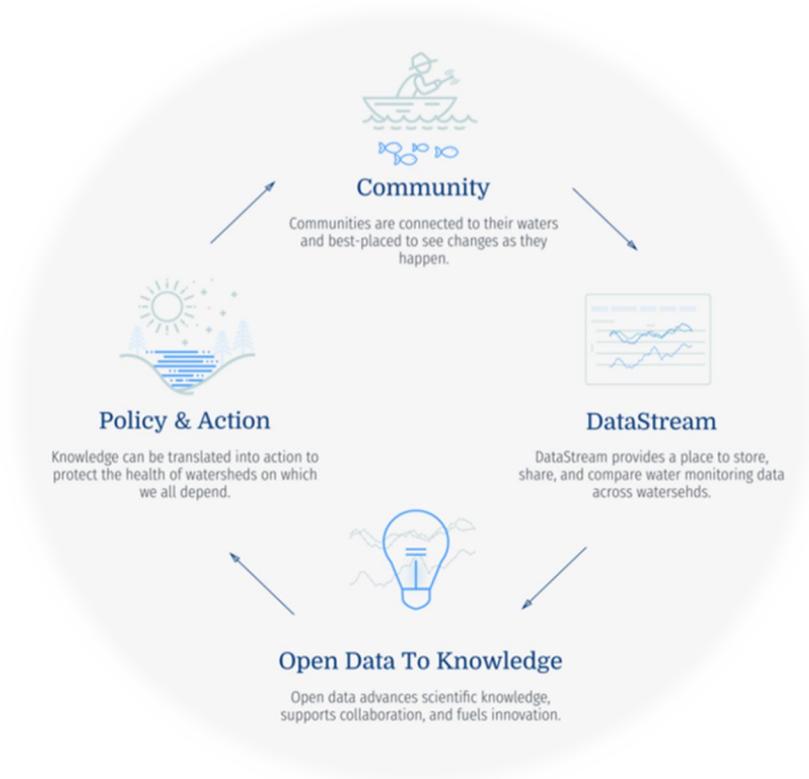
DataStream is a free open access site that holds Canadian water quality data. It is a platform that addresses barriers to freshwater data access and sharing of freshwater information. It is an online mechanism for publishing and assigning Digital Object Identifiers (DOIs) with a robust data standard (i.e., the US EPA WQX schema). As of today, there are four distinct datasets representing different geographical extents (from Western to Eastern Canada: Mackenzie, Lake Winnipeg, Great Lakes, and Atlantic). These datasets represent over 120 groups that contribute more than 3 million observations at over 7,000 sites and growing. Contributors include community groups, watershed organizations, academics, Indigenous governments, provincial and territorial governments, and the federal government.

DataStream is a program, not a project that can be tailored for specific regions, communities, contexts. It is important to have such flexibility in a platform to consider unique needs all while maintaining a national vision that includes the needs that are shared across regions and ways to work across sectoral and jurisdictional boundaries.

While designing and developing DataStream, lessons were learned regarding repurposing data from previous water data hubs that had gone stale, building upon existing data and metadata standards as well as keeping a focused scope to be successful (i.e., being clear on what we are building and what we are not doing):

- The concept of building a community is crucial for such an online platform. It is important to make data sharing tangible before expecting buy-in from data providers and users. It is also important to know and understand the contributors and partners through various engagement to better support them.

- To be resourceful, DataStream has implemented the 'Adopt, Adapt, Build' principle to ensure that existing technology and standards be utilized wherever possible, instead of starting from scratch each time.

- It is also important to note that technology is only part of a solution. It is important to provide the proper resources and support along with real incentives that include both rewards and penalties.

- 'Open Access' is mandated, and the discoverability of data users is also considered.

- Using a networked approach to data delivery to be insightful on what platforms can do and not do to know how best data contributors can share their data and connect with other data providers and users.

The following image is a schematic representation of the knowledge mobilization process used by DataStream communities which takes community-based monitoring data, shares this information as open data on a platform that in turns informs decision-making and policies.

Community
Communities are connected to their waters and best-placed to see changes as they happen.

DataStream
DataStream provides a place to store, share, and compare water monitoring data across watersehds.

Open Data To Knowledge
Open data advances scientific knowledge, supports collaboration, and fuels innovation.

Policy & Action
Knowledge can be translated into action to protect the health of watersheds on which we all depend.

For more information, please visit www.DataStream.org, or contact Carolyn Dubois (Executive Director, Water Program) at Carolyn@gordonfn.org.

MS. JANICE L. SHARPE & MS. SONIA TRENTIN

Ms. Janice Sharpe has been the Senior Director of the GoC's Federal Geospatial Platform since 2018. Ms. Sharpe returned to her roots in geomatics when she joined Natural Resources Canada 5 years ago. Previously, she held leadership positions at Agriculture and Agri-Food Canada in environment, science and technology policy and program delivery; during this time, she also led several strategic planning initiatives at senior levels in the department. She first joined the federal government as a Geomatics Project Manager at Public Works and Government Services Canada after leaving the private sector as Area Manager of Triathlon Mapping Inc. Ms. Sharpe possesses ITIL and Balanced Scorecard certification and holds a Bachelor of Science in Resource Management from the University of Guelph, with specialization in geographic information.

Ms. Sonia Trentin has been the Federal Geospatial Platform Data Manager since 2018. Some of her responsibilities include the provision of support in standards and governance for data sharing, and the addition and integration of data from several federal and provincial organizations into various open platforms, such as the Federal Geospatial Platform and Government of Canada Open Maps.

A group of federal freshwater experts were tasked with conducting a Freshwater Data Dissemination Scan to:

- Take stock of federal data governance and dissemination regarding freshwater data;

- Review the existing standards for freshwater data;

- Identify challenges, such as discoverability, interoperability, access, integration, and gaps that limit the accessibility and usability of freshwater data; and

- Provide a set of recommendations and potential solutions.

There are key considerations regarding the current data and information environment in Canada that will greatly impact data sharing of freshwater data:

- Rapid acceleration of data creation;

- Technology transformation;

- Rising expectation of free and easily accessible data;

- Increased initiatives and policies that promote data sharing and access;

- International standards for data sharing and exchange; and

- Concern over individual privacy as well as personal and national security.

CWA could play a role in creating or coordinating a robust framework for freshwater data sharing across the country. Several resources have been identified as 'building blocks' for enhanced freshwater data sharing in Canada that could be utilized by data providers and users. These include:

- A Data Strategy Roadmap for the Federal Public Service: https://www.canada.ca/en/privy-council/corporate/clerk/publications/data-strategy.html

- Open Government Partnership: https://www.opengovpartnership.org/

- Federal Open Government Directives: https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=28108

- Open Government Portal: https://open.canada.ca/en
  This platform currently holds 29 Open Information Water Records, 1156 Open Data Water Records, and 600 Open Maps Geospatial Water Records. This information comes from federal departments and organizations, including Crown Corporations (71), Provincial Governments (namely Alberta, British Columbia, Ontario, and Québec). Moreover, Open Maps includes over 4,500 interoperable data layers available from 21 federal departments and 4 provinces.

- Provincial/Territorial Open Government Directives and Portals.

- The Federal Geomatics Accord and the Canadian Council on Geomatics: http://www.ccog-cocg.ca/

- Others, such as the many collaboratives and data sharing initiatives ongoing across Canada:
  Province of Québec Atlas de l'eau, Gordon Foundation – DataStream, Spring Flooding, Vegetation Drought Response Index in the Prairies, Aquatic Species at Risk, Real-Time Hydrometric Data Map Search, Crowd-Sourced Water Data, Provincial/Territorial Water Data and Tools.

Focusing on federal government freshwater geospatial data, the following table offers a snapshot of Open Government types of water data available and their sources:

Type of Freshwater Data	Source
Releases to water	National Pollutant Release Inventory, ECCC
Releases of mercury, cadmium, and lead to water	ECCC
Tides and water levels	DFO
Agri-environmental indicators: pesticides' risks to water contaminations	AAFC
Average water yield 1971-2013	StatCan
Ratio of surface water intake to yield 2013	StatCan
Water quantity at monitoring stations	ECCC
Biweekly soil moisture anomalies	AAFC
Climate-moisture scenario 2011-2049	NRCan
Standardized precipitation index	AAFC and ECCC
Annual water quality monitoring	ECCC
Contaminants in fish 1979-2002	DFO
Drinking water advisories for First Nations 2018	Health Canada
Water turbidity at drinking water intakes 2013	StatCan
Aquifer vulnerability	NRCan
Groundwater and aquifer vulnerability	Government of Alberta
Wells and geochemistry	Government of British Columbia

The sharing of geospatial data has allowed the development of a sort of guidebook for releasing open data. The data value chain is as follows:

1. **Expedite Access to Data:** Open government license, policy on service and digitization of data, open by default, and federated and closest to the source.

2. **Data Preparation and Integration:** Create maps from datasets where appropriate, data formats, data analysis and conditioning, access to data, services, and catalogues with Application Programming Interfaces (APIs).

3. **Data Dissemination**: Data/metadata quality, metadata creation based on standards, authority to release form, dissemination of data to open portals, maintenance/update/archive.

Data dissemination standards and policies, such as international and national open standards distilled into practices and operational policies for all partners, is key for establishing an interoperable platform. International standards bodies include: OGC, ISO, W3C, and IHO. National standards bodies include Standards Council of Canada, and Canada Forum on Geospatial Standards. Other standards include the Canadian Geospatial Data Infrastructure (OGC Canada Standards Forum) and the TBS Policy Suite and Open Government (Policy on Service and Digital, Open Portal, Open by Default).

To be noted, Canada's new GEO CANADA Website (https://geo.ca/) is a big step forward for open geospatial data in Canada. It is a neutral platform where users from all levels of government, industry, academia and more, can discover the geospatial information that is important to them.

This review of freshwater data dissemination in Canada has revealed several challenges and opportunities:

- Data is distributed across organizations and jurisdictions, where only some of the data are harmonized across jurisdictions, watersheds, etc.

- Some data is licensed.

- Water-related products are not always current.

- Some data is held by organizations and not easily findable and accessible.

- Investments, collaboration, and time is needed to develop such a dissemination strategy.

- There are international considerations to be taken.

- Canada has a variety of 'building blocks' to be used and resources as well as platforms to be leveraged in building a new CWA.

- Standards exist and need to be applied, such as the implementation of the Findability, Accessibility, Interoperability, and Reusability (FAIR) principles for scientific data management of data/digital assets.

- Adopting a federated system by applying the concept of keeping data closest to the source.

- Drive an Open Government culture.

PRESENTED BY MR. JAMIE SMITH

Mr. Jamie Smith began as Environment and Climate Change Canada's Chief Data and Results Officer on July 6, 2020 and comes from a strong background in data management and analytics both within and outside the department. Mr. Smith has held various posts within the federal government including at Environment Canada, the Privy Council Office, and the Treasury Board Secretariat. Mr. Smith returned to ECCC in 2008 supporting the Ministers office and has since concentrated on water, weather, and climate data; earth observations; monitoring network planning; and collaborating with provinces and territories to establish agreements to share data before assuming his current position.

The goal of developing a National Freshwater Data Management Strategy is to ensure that all Canadians can find and use all essential freshwater data. The proposed National Freshwater Data Management Strategy encompasses Data Access Policy, Metadata, Data Quality, Data Archive, and Data Dissemination.

A Data Access Policy would include principles to ensure that all data resources are open by default and released as open data (i.e., freely shared, used, and built on without restrictions), unless it is subject to valid exceptions, such as ownership, security, privacy, and confidentiality. This would also ensure that open data and information is released in an accessible and reusable format to enhance interoperability.

Metadata principles include self-declaration for freshwater platforms collecting data, declared standards for the collection and development of freshwater products, discovery of metadata being available to facilitate data discovery, access, and retrieval. Moreover, observational metadata should describe the observed variable, the conditions under which it was observed, how it was measured, and how the data has been processed, to allow users to confidently determine whether the data is appropriate for their application.

There is also a need to improve the overall quality of freshwater data to enhance the usefulness of observations being exchanged. The principle of 'Known Quality' should be applied to have an accurate representation of the data and the degree to which it describes the value of the variable needed for a specific purpose. This principle needs to be coupled with quality assurance and quality control measures. Quality assurance is understood as a system of planned and systematic management activities necessary to provide adequate confidence that data, products, or services will fulfil established quality requirements. Quality control is a system of operational techniques and activities that measure, assess, and characterize the quality of data, products, or services. A framework that encompasses all these components is needed to ensure that freshwater data being collected in Canada is of high quality.

Data archiving is also crucial to ensure that all Canadians have access to essential freshwater and information, including observations, modelled predictions, and other products. A long-term repository of freshwater data and information as well as timely access to archived data and products with best practices is required to maintain and enhance a forward-looking infrastructure that retains and provides access to all non-real-time data products.

Finally, a freshwater data dissemination strategy is needed to ensure that Canadians have the tools to find, access, and visualize freshwater data and information products. These products and tools must be developed according to users' requirements, which will consider purpose and sophistication. Access mechanisms must also guarantee that the data is being disseminated with proper attribution to its rightful owner, yet freely accessible without restriction. A coordination mechanism is warranted to enable decision-making, share information and ideas, and determine accountability. Principles of governance are needed to support long-term strategic, efficient, effective, and responsive data management practices for freshwater data and metadata. Governance principles include:

- Agreed upon priorities and work plans that ensure key products and services are being provided;

- Potential benefits, risks, or repercussions being fully understood and discussed collectively; and

- Strong representation of both service providers and users/clients to properly guide decisions.

BREAKOUT SESSION 2

All workshop attendees (including panelists and presenters) were assigned to smaller groups (2 breakout groups per discussion area with ~10 participants per group) to have more focused and significant discussions on three questions related to the availability and accessibility of Canadian freshwater data. Again, areas of discussion included Water Quantity, Water Demand and Use, Aquatic Ecosystems, and Water Quality. The following subsections summarize the key points that were made by participants for each question that was discussed during the Day 2 Breakout Session.

Q1: WHAT VISION DO YOU SEE AS APPROPRIATE FOR THE CANADA WATER AGENCY FOR MANAGING FRESHWATER DATA WITH THE OUTCOME THAT CANADIANS ARE ABLE TO FIND AND USE ALL ESSENTIAL FRESHWATER DATA?

Water Quantity

- Facilitation of discoverability of datasets related to water within Canada (internal and external).

- Aiding in finding datasets in a timely way (i.e., ensuring that datasets are made available or discovered more rapidly), and interoperability of the data so it can be utilized by a larger group.

- Making raw datasets available to be utilized in research and analysis. For example, the Water Security Agency (WSA) could provide interpretation of data (i.e., data analysis) so that the public can understand what the data means.

- Provide recommendations, standards, and guidance on best practices as a central hub of knowledge.

- Education and Outreach to bring data users up to speed on available resources and previous decisions (e.g., Freshwater 101 course), including the enabling of efforts at all levels (e.g., provincial, municipal, etc.).

- Vision statement that includes the quality and integrity of data, including the importance of data quality to enable secondary data use, with recognition that different strategies may be necessary for different provinces/territories.

- Leadership role to bring provincial, territorial, Indigenous peoples together and support them to allow for work to be done at their respective level of comfort with regards to data and data management.

- Incorporation of metadata that shows the quality and limitations of a dataset so end-users can determine how the data can be used.

- The strategies and principles that are consistent with other agencies' initiatives.

Water Demand and Use

- Facilitate access to freshwater data in Canada as an informed convenor of opportunities for people to get together and collaborate on data standard, and an organization that advocates and provides funding that facilitates access to information, since many Conservation Authorities do not have the in-house resources needed.

- Freshwater data to include groundwater to ensure that all freshwater data is included interconnected (i.e., surface and groundwater/aquifer data).

- Facilitating the use of data in decision-making and policy processes. For example, bridging different initiatives and bringing together open data initiatives at the provincial and federal levels to then disseminating this information to regional groups.

- Address concerns about building another website/data portal as another branch of ECCC. Perhaps, CWA could be a branch of the Canadian Council of Ministers of the Environment (CCME) that is provincially mandated.

- Decentralizing by providing more regional/local reports since there is a need to build local bases and help coordinate a network for data sharing.

- ECCC currently supports federal contributors of data by ensuring that csv files are standardized, etc., and by providing training, GIS development, etc. It also works with provinces and territories to integrate their open data and aiming to have all data on the Open Data Portal in the next two years with evolving the standards for metadata between all departments.

- Discoverability of data for all Canadians and abroad is an excellent vision for CWA as it relates to the challenges at different geographical scales and could be a gateway (i.e., inventory) or at least a place to start a search.

- Data being collected by "professionals" who have been trained, believe that we can start data quality control by showing a ledger that provides the "training" of the individuals or the calibration of the collecting unit (i.e., sensors). This relates to defining what is essential data, e.g., base map, slow data, and then other types of data.

- It is important to ensure a minimal level of quality for freshwater data to enable their use in analysis and in decision-making. It is a challenge to incorporate additional sources of data that will become available and understanding what data is appropriate for what use. Educating the public related to 'Known Quality' of data so it can more accurately support decisions. If the audience is all Canadians in general, then they will require a different quality of data than scientists will require.

- CWA could be a facilitator of data standardization, data quality, metadata, and a facilitator of the compatibility of data, and could even maintain an inventory of data proposals. This would highlight 'who is doing what, where, and how they are doing it' which could incite some governments (i.e., provincial, territorial, and regional) to do studies in their area in the same way as in other areas to enhance connectivity.

Aquatic Ecosystems

- A framework where freshwater entity is considered and allows data to be handled in a standard way (e.g., freely findable metadata/data). Standards should also consider global sharing of freshwater data.

- Guidelines for an agreeable data model, like DataStream, or simply managing the existing repositories to ensure that data is harmonized (i.e., format, quality, etc.).

- Start with ensuring that decision makers, regulators, etc., can make their decisions based on good quality data to ensure impact on policy.

- Connecting the plethora of organizations and government bodies working with freshwater data through funded collaborations.

- Supporting resources are necessary since different groups have different means to reach parity across Canada.

- Federal organizations will need to break down their own silos and share between themselves.

- There is a need for centralized management to ensure quality and respect privacy. Not all data is good data or useful; therefore, it is well within the mandate of the agency to act as a manager of data.

- Promote data access and act as a helper to find data and link datasets (e.g., NRCan linking geospatial objects to different data types). CWA could facilitate linkages and discoverability.

- Foster the use of data by funding data events and opportunities such as outreach and education activities, knowledge mobilization means, hackathons, etc.

- Crosstalk between different standards to facilitate interoperability instead of having agreement over one standard.

- Connect data users with data producers/contributors to foster a sense of community (i.e., two-way sharing).

- Identify gaps in freshwater information and data that is needed across the country at all levels.

- Trust and coordination are key, especially for building relationships with Indigenous communities and reaching out to communities from multiple directions.

Water Quality

- Accessibility and interoperability are missing from Q1. The FAIR data principles all need to be utilized.

- Need to clarify how this process will help the federal government to make policy decisions based on this data. Anyone contributing data will want to know about the outcomes from their data. Moreover, there is a need to clearly understand what the government is doing with freshwater data collection and what the data is used for to inform the public.

- Thorough engagement and consultation are needed to determine 'essential data'.

- How are monitoring programs and research programs integrated in government? If data is coming from many different sources, standards are needed to give a path for others to follow in terms of data quality.

- Need a stream for Indigenous knowledge and data. FNIGC has framework for data, but if they had a storage facility to decide how data is stored and then control the access, this could be part of a system.

- Interoperable data between the regional, local, national scales (e.g., water accounting needed at all scales and need to maintain data accounts at various levels, need data available at various levels). Networks can be set up and maintained for national models or provincial models by rolling up data from local level all the way up to national level.

- 'Rolled up data' is like the concept of hierarchal relationships on water quality data and metadata for high level indexing of the data, and to allow data to be linked to multiple sources.

- Need a tool for discoverability – a one-stop-shop for federal water data and data from across Canada, pulled in from different places. Water Quality Exchange (WQX) tool of the US EPA is a potential model since it pulls in data from different places to provide a more complete picture including visualization of where gaps are, including data of other places and other times that were not part of the US federal monitoring data.

- Means to have local collectors of data to share their standard used to collect the data, and the tools available for translating between different standards to ensure interoperability.

- Beyond a place to find the data, there is a need for people (i.e., staff) that are available to help data users tailor and find the data needed.

- It is not just freshwater data that users and owners are looking for. They sometimes require other types of data too. How is freshwater and other data going to be connected and linked?

- Need two-way communication and feedback for freshwater knowledge across Canada. Furthermore, users need to be informed when data does become available – there is no communication to know what data is needed and when that new data becomes available.

- Any good dataset would have an identifier to go with it, like a DOI, or some other sort of identification system. Identifiers help link data for interoperability and can be used on the internet so that it is easy for anyone to look up on search engines.

- Governance in establishing standards and an infrastructure for linking of data. For example, CWA could host freshwater metadata. Not only water data, but also needs to include other kinds of data, such as soil and elevation models which directly impact water quality.

Q2: DO WE NEED A NATIONAL FRESHWATER DATA MANAGEMENT STRATEGY? IF SO, ARE THESE THE KEY COMPONENTS AND WHAT ARE SOME CONSIDERATIONS (DATA ACCESS, POLICY, METADATA DATA, QUALITY DATA, ARCHIVING DATA, DISSEMINATION, ETC.)?

Water Quantity

- Need to research what strategies have worked with accessibility as the end goal and use existing strategies and databases as examples for how we might develop a freshwater data management strategy. There should be a strategy to ensure the availability and timeliness of data as well as to provide archival data for historical analysis.

- Leverage examples from other countries that have done significant work in data management and tailor it to our own needs.

- Consider the collection methods that are used to collect freshwater data, including collection methods and data storage.

- Have an 'Open by Default' policy worked into the strategy to help leverage and manage expectations. This includes machine readable data to avoid proprietary data formats so that data can be accessed by all.

- The "portal" approach will not be sustainable if it tries to meet too many needs. Using hubs to point to other data management systems where data is stored could be a solution to this.

- Convene and coordinate different groups regarding their needs and concerns for a National Freshwater Data Management Strategy.

- Robust metadata fields that offer data context, such as how the sample was analyzed, who collected the data, etc., are needed to ensure appropriate usability. This could even allow agencies to be further contacted about metadata, if needed. Reference from the USA on standardized metadata for secondary use of water data: https://www.sciencedirect.com/science/article/pii/S0043135416309642

- Commonality in grading specifications for the quality of data as different provinces may be using different standards/specifications.

- Special considerations when looking at historical data that is in other formats (i.e., paper, hard data storage, etc.) and converting them into electronic formats (i.e., coordinated effort for the digitization and modernization of historical data).

Water Demand and Use

- Driving standards and interoperability by integrating data from the source.

- Have a standardized way of distributing data to those requesting it and not reinventing a new data portal to avoid being redundant.

- Point for authoritative sources of info that includes guiding principles, advocating for open data, and using federal government capacity to promote others to put their data online, e.g., those that are funded by federal government to get it into a data portal.

- Lots of work being done by First Nations Management Centre in terms of data management and hopes for connections and integration between their data management systems.

- Wealth of privately-owned information that could be very useful. Private industry data, should it be considered as public information. For example, environmental data assessments need to do some of their own data collection to subsidize existing data, but sometimes you need to pay for data. Moreover, some data is free and available, but not easily accessible (i.e., not in a database or system that allows for easy access or is easily searchable).

Aquatic Ecosystems

- Should the strategy relate to a common standard or clear policy?

- The typical approach for data quality is 'good enough, not perfect'. We should be focused on sharing the data quickly and be open about the quality of data (e.g., fish locations - sharing locations when collected, and adding in details later).

- Freshwater involves many different levels, so there is a need to manage all involved. The five key components could be prioritized to achieve standards for platform inclusion (e.g., Ontario does not deal with saltwater, so any saltwater material would have to be developed from scratch).

- The strategy should be driven by the data users and providers, and their needs as well as rooted in open standards.

- There are multiple copies of data floating around, and it becomes a data management issue of determining who keeps them consistent and authoritative.

- Education to help users understand the uses of data since often users do not understand the use cases. Furthermore, training and resources are required to support adherence to any national standards established by CWA.

- In the United States, organization grades citizen science on a scale, such as suitable for education purposes, for litigation, for policy, etc., which is a key outcome to identify appropriate uses for data based on quality.

- Groups that are currently hosting data are doing it well within their specific scopes. The CWA could help in terms of pooling different nodes together.

- Providing guidelines for existing repositories and help with cross-walking to include listing guidelines for groups that are just starting out. They could be generic (e.g., https://schema.org/) as a starting point and move onto more sophisticated standards to help inform metadata and data quality.

- The persistent issue of ownership of data for Indigenous people and commercial providers could be addressed by the CWA to clarify ownership and facilitate access. It is important to note that the lack of capacity can be the issue for providing access to information. The CWA could also help with support and/or capacity.

- The Canadian Standards Association is developing metadata standards for hydro-climatological data – some federal activity is already happening and perhaps there is room for more work on this for the CWA.

- Open license datasets are not necessarily accessible to the public – what would fully open access to the public look like? Additionally, visualization tools would be more helpful for public engagement and education. The Canadian Centre for Cyber Security (CCCS) is another example of making climate data "readable" for the public. It is important to focus on what data the average citizen is looking for.

- Reference data is extremely important and hard to access (i.e., it is difficult to get the data that needed to reference the data that is being collected). There is a need for making it more easily accessible and to couple this data with guidelines for Community-Based Water Monitoring (CBWM). There are many CMWM organizations doing a lot of work locally that could be made more discoverable.

- Need a clear and prioritized audience for CWA. There are various levels of needs for the data and might be important to start with more strategic goals for higher level users as a first order of priority.

- It is important to consider the cultural dimensions in what the federal government is doing and might benefit from a cultural shift based on what is working and what is not (i.e., engagement mechanisms are needed between federal government and communities).

- Reducing the number of silos within the GoC is important for the CWA to address regarding freshwater information and activities.

Water Quality

- Data use is missing from the list above, specifically regarding how the government is using data to inform policy.

- Metadata and other parts are important, including the perceived quality of the data (e.g., data that is less perfect should be clearly specified, need to identify if there is data that exists but is currently embargoed, etc.).

- Need a framework for accessing the freshwater data and the metadata that includes a standard comprising of information such as government use of the data, why the data was collected, and other context around the data so that the data is useable at local, regional, national scales.

- Historical data is very valuable for understanding water patterns and other challenges, and long-term data sets are highly valued because there are not many of them. Considerations for archiving data need to be included in this strategy. This should also include considerations for making archived data interoperable.

- Reanalysing archived data is done routinely to improve models. Reanalysis software creates new data from the historical archived data; there are times when past data can be brought forward and reanalysed in new context.

- Interoperability within Canada needs to be at different scales, across all jurisdictions, and should start at the collection standard level.

- Data is now often stored on 'the cloud'. Cloud-based storage means we do not need data storage in the same way. The cloud is cost-effective, and the government gets deals from cloud providers for storage, yet there are higher costs for moving and downloading data that need to be considered.

- CWA should consider providing the models, and information based on the data (i.e., the freshwater interpretations and products) as a more cost-effective solution.

- Need to consider data collection, data use, and data standard aspects possibly by leveraging data tools to create a 'sandbox' that allows users to play with data instead of having to download the data.

- Data quality standards can be fit to purpose (i.e., not all data needs to be of the upmost quality but needs to be up to the quality for what it will be used for). CWA should avoid a universal high standard for all data, but rather provide different standards for different uses of data. Moreover, requiring high level data may be limiting (e.g., local groups may not have capacity to collect data to the high standards of federal data).

- There is a need to consider users' need along the way. For instance, research data needs would be different than local municipal water managers' needs or recreational data users.

- CWA should try to implement the Global Water Futures (GWF) data strategy by ensuring that it is actionable, adding guidance and infrastructure so scientists can easily contribute, and addressing what is sensitive and what is not.

- National strategy should follow the 'Adopt, Adapt, and Build Upon' process.

- Data must be as open as possible and as close as necessary (i.e., open by default) while defining the owner and considering specific requirements.

- Some concepts in the Beijing Declaration on Research Data (CODATA) are helpful in thinking about research data: https://codata.org/events/science-and-policy-workshops/codata-and-codata-china-high-level-international-meeting-on-open-research-data-policy-and-practice/the-beijing-declaration-on-research-data/

Q3: HOW DO YOU SEE WORKING WITH THE CANADA WATER AGENCY ON FRESHWATER DATA?

Water Quantity

- Provincial data is freely available upon request (with disclaimer and referencing), but rarely are the sources cited. It would be beneficial if the province shares data with the CWA, if the source were acknowledged/cited when the data is used. If the data is to be 'amalgamated' into federal databases, we risk losing the ability to track how provincial data is cited.

- Marketing the availability of the data by advertising the datasets that are available (i.e., sources and links).

- CWA should look to build and capitalize on the groups with the resources already in place (e.g., Our Living Waters [126 organizations] network). Also, community-based water monitoring mainly provide the baseline for science and policy. Government should leverage these types of groups to gather data and support them with proper funding (i.e., in a long-term manner instead of project-based) and a digital infrastructure for modernized data collection.

- Provide support in data management since resources do not always exist within smaller groups, including training to allow these groups to contribute to a national database.

- Provide infrastructure so that smaller data providers can add to the database that they do not necessarily have access to currently, including an infrastructure and the training to get data into formats that can be useable.

- CWA could look at building a system to better integrate systems since some providers do not have the knowledge and resources of adding metadata to enhance data discoverability.

- Developing a portal where the public can enter the data into the system easily.

- CWA could make documentation easily accessible and communicated to everyone utilizing the data to help prevent confusion that data trends are not inferred as a trend where it was due to a change in analysis method or lab source. For instance, elevation data between Saskatchewan and Manitoba are different and this difference is associated with the method of collection and not absolutely by observations.

- Surface water quantity monitoring has a National Administrators Table to allow provinces to discuss strategy and policy. CWA Data management could see a similar governance structure. This could be extended to other aspects of freshwater such as groundwater, atmospheric monitoring, etc.

- Conservation Authorities (CAs) produce lots of data that is not out there for the public to consume. CAs are strapped for funding and may not have the time to interact with CWA, which may deter them from pursuing data sharing. A simplified approach is required to reduce the overhead needed to contribute to a national management strategy.

- CWA could develop education material around standards to facilitate working with other organizations (i.e., the creation of best practices and standards that other organizations can access).

Water Demand and Use

- Sharing or making data available as a mandate to ensure that potential users make their data available to CWA to allow CWA to make the proper connections between those with the data and those that need the data.

- There is potential for a freshwater data governance strategy.

- For small organizations, there is a fear of sharing data (e.g., misuse). CWA could provide legal advice or guidelines to protect from them from these harms, while allowing open sharing of data. Furthermore, CWA could promote organizations that typically hold but do not share data to do so in a way that protects their interests, but still makes it available for others (e.g., consulting industry data).

- Potential funding programs to make data more accessible with the end goal of more strongly linking data and policy. For instance, a system in freshwater policy where datasets used to make these decisions are referenced and to ensure the use of data in policy making.

- Identify gaps in freshwater data and metadata and suggest standards for usability and interoperability. This would need CWA to offer support to be able to provide standardized data training (like CABIN) on data collection, management, standardization, etc., and facilitating discussions with all organizations at all levels.

- CWA should consult with water surveys, data management, etc. Water surveys are done differently depending on the province and provincial/territorial governments need to work with CWA to foster standardization to make sure that whatever work they are doing is useful for other users.

- Two-way dynamic: providing some bridging function, guidance around standards, new information, and funnel information down into the regional level while providing feedback at the national level.

- Work closely with provinces and territories to identify relevant and useful freshwater data sets. This also helps provinces/territories to feel the ownership of their data.
- Work with scientists to see how data is transformed from raw data into useable data products.

Aquatic Ecosystems

- Data should reside in the owner's control to avoid unmanaged duplication/copies, etc., but making data discoverable via CWA.
- Having ~200 employees would really enable CWA to act as a connector to interact with NGOs, Indigenous Nations, etc. If smaller, it would have to focus on a few key priorities to keep it from just being an intergovernmental policy instrument.
- Establish connections with community groups, industry, academia, that are collecting data that is less easily discoverable. Many freshwater data users are interested in community/citizen science, as an educational or engagement tool where CWA would have a liaison role.
- Caution around the funding at the expense of existing activities (i.e., ECCC, DFO, etc.), including the resource pressures on these organizations resulting from the need to be more coordinated with the CWA.
- With Aquatic Ecosystems there is an opportunity and space to get really complicated and to speak to values besides just numeral data; therefore, it is important to determine what we value and why we value these aspects within CWA conversations.
- Community-based organizations can also work as information dissemination arms (i.e., knowledge mobilization mechanisms) via the CWA as they are already well connected with communities.
- A map of all freshwater-related organizations across Canada would be a very helpful tool to be developed by CWA.
- CWA needs to push for more remote sensing which requires funding and capacity.
- CWA could help mobilize the various collected data to policy makers by making data understandable and relevant to local and regional scales.

Water Quality

- Is there a mechanism for data users to request for specific data (e.g., data user could call for data in geographical places that have a scarcity of data)? If there is a linked system, it makes it easier to see the gaps, including geographical data gaps, and to see what users' needs are. There needs to be engagement with users to know what data is needed, when and where.
- A registry could be integrated with data from the federal government and bring all data sources to the forefront to help organizations work together. Moreover, integration is needed to understand the policies that rely on the freshwater data.

- CWA could possibly play a role in curating data to ensure that the data fits the purpose while avoiding censorship of data.

- CWA to have a coordination role to ensure a more common approach across Canada (e.g., national standard) by involving more regional specialists (e.g., specialist in Atlantic Canada, etc.)

- IISD has a lot of international experience through their national adaptation program and would love to see Canada as a leader in freshwater areas (e.g., economic value of water technology).

- CWA needs to play an educational role (e.g., provide training, workgroups, webinars for field professionals and students, etc.).

- CWA could become an international leader for Water Quality. The World Meteorological Organization (WMO) already have things in place for Water Quantity, but there is a gap for Water Quality and developing countries need guidance.

- Metadata catalogue on water data by partnering with other data catalogues.

- The GoC used to host an international UN effort towards Water Quality data: https://gemstat.org/about/

- Provide data access tools to developers so they can use the data the way they want. If people do not have the proper licenses for certain proprietary software hosting this data, they may not be able to access it.

- Adopt the Open Science principle of 'open by default'.

- FRDR: https://www.frdr-dfdr.ca/repo/

GENERAL QUESTIONS/COMMENTS FROM BREAKOUT SESSION 2

Education and Outreach:

- Broaden participation in freshwater monitoring and management by leveraging the wide growth of interest and involvement in water monitoring.

- Encourage the planning and decision-making on the part of Indigenous and other citizen-led groups.

- Need for careful shepherding through outreach, education, and training using various formats (e.g., CWA regional centers, partner governments, non-government groups that have national scope, such as WWF, Gordon foundation, LLC, etc.).

- Education subjects should cover the "life cycle" of freshwater data (e.g., scientific methods, project planning, preparation and execution of field work, data management in all its forms, data analysis and interpretation, reporting, and data use in land/water use planning and decision making).

Repository of "Use Cases":

- Develop a library of "use cases" for freshwater data to increase interest and confidence in freshwater management.

- Support community-based science and monitoring by demonstrating how "good" data can and should be used in various types of planning and decision-making.

- Build momentum for the programs necessary to meet the CWA objectives (and other governments and organizations) across the country.

A Distributed Approach:

- The initial inventory of federal freshwater datasets is incomplete, and that requires more effort to ensure more geographical coverage.

- Efficient use of resources may be through recruiting organizations with regional/local knowledge and fostering relationships with those generating the freshwater data needed.

Geospatial Freshwater Data:

- Geospatial information is crucial in many aspects of freshwater monitoring planning and data use (e.g., data searches, analyses, interpretation/visualization, reporting).

- It is usually expensive to acquire over broad areas but should be on the list of data types that the CWA needs to consider.

Technology:

- Growth and use of new technologies for freshwater data generation and management is accelerating, and could continue to do so with CWA support, especially in the context of translating innovations into actions.

Consultation with Provinces and Territories:

- Jurisdictional overlaps between governments will highlight which governments have made significant progress in aspects of freshwater data management.

- Overall lack of consultation related to resources in provincial and territorial governments.

- Provide incentives to fully engage governments (e.g., executive level instructions for program staff to engage, financial compensation for consultants or non-profit groups to assist in the engagement process, etc.).

PRESENTED BY MS. LINDA LEE

Systemscope Inc. has been contracted by ECCC to conduct a Freshwater Data Environmental Scan. The objective of this task is to take stock of existing non-federal freshwater data, freshwater data platforms and related metadata across Canada. The approach being used is two-fold:

1) Web-based scans to find and review accessible freshwater data; and

2) Engage with participants to understand who has freshwater data (i.e., data providers) and what they have (i.e., types of freshwater data).

Attendees who would like to participate in this inventory are encouraged to contact Jean-Guy Zakrevsky (jean-guy.zakrevsky@canada.ca) and Linda Lee (lee@systemscope.com).

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- Jeffrey Hackett, **The Firelight Group**

- Carolyn Dubois, **The Gordon Foundation**

- Lindsay Day, The Gordon Foundation

- Mary Kruk, The Gordon Foundation

- Patrick LeClair, The Gordon Foundation

- Will Farrell, The Gordon Foundation

- Ted Yuzyk, **International Joint Commission**

- Ray Rabliauskas, **The Pew Charitable Trusts**

- Maggie Xenopoulos, **Trent University**

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- Brendan Martin, **U-Links**

- Frederick Wrona, **University of Calgary**

- Tricia Stadnyk, University of Calgary

- Becky Cook, **University of Manitoba**

- Claire Herbert, University of Manitoba

- Dave Sauchyn, **University of Regina**

- StephenO'Hearn, **University of Saskatchewan**

- Bhaleka Persaud, **University of Waterloo**

- Nancy Goucher, University of Waterloo

- Mike McKay, **University of Windsor**

  W

- Dillon Koopmans, **Water First**

- Kendra Driscoll, Water First

- Gabrielle Parent-Doliner, **Water Rangers**

- Kat Kavanagh, Water Rangers

- Darryl Dormuth, **Water Security Agency**, Government of Saskatchewan

- Kei Lo, Water Security Agency, Government of Saskatchewan

- Shaun Hase, Water Security Agency, Government of Saskatchewan

- Catherine Paquette, **World Wildlife Fund Canada**

  Y

- Edda Mutter, **Yukon River Inter-Tribal Watershed Council**