Yukon Water

A Summary of Climate Change Vulnerabilities

Funding for this report was provided by
Indian and Northern Affairs Canada
Climate Change Adaptation Program

Copies available from:

Environment Yukon
Water Resources Branch, V-310
Box 2703, Whitehorse, Yukon, Y1A 2C6
Email: water.resources@gov.yk.ca
www.environmentyukon.gov.yk.ca

ISBN 978-1-55362-517-9
© Government of Yukon
Published March 2011
All photos Yukon Government

Printed on 100% post-consumer recycled paper.

This report is a summary of Yukon Water: *An Assessment of Climate Change Vulnerabilities* | ISBN 978-1-55362-516-2

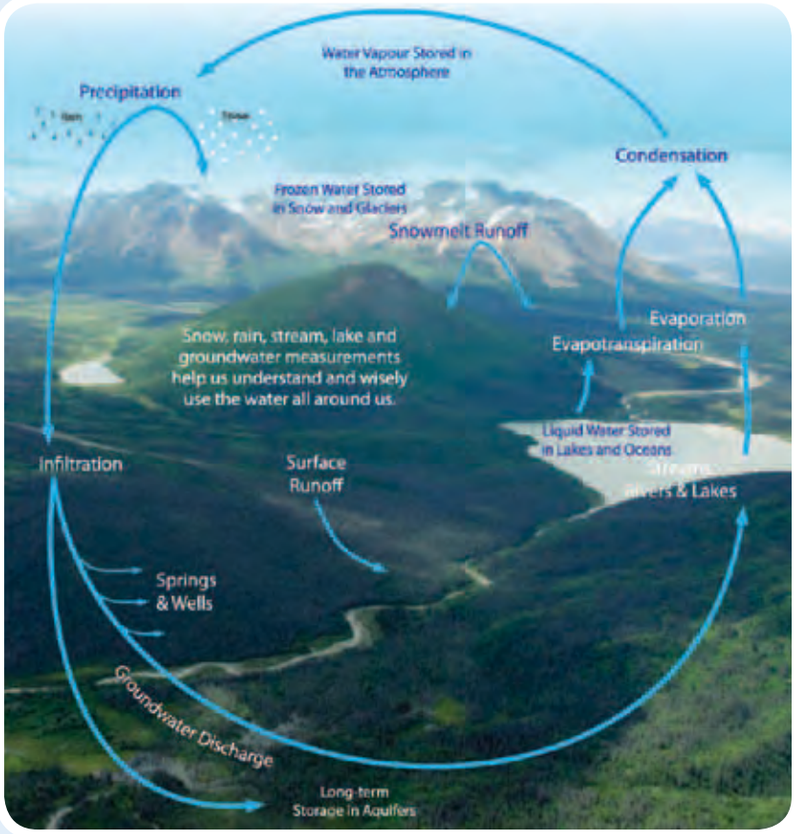
Yukon Water

A Summary of Climate Change Vulnerabilities

Yukon Water Resources in a Changing Climate

Climate change is already affecting Yukon's water resources, and the impacts will increase in the years to come. Everything's changing—precipitation, snowpack, permafrost, glaciers, streamflow, even the quality of the water in Yukon's lakes, streams, and rivers.

To be ready for the future, Yukoners need information. In particular, the people and agencies managing Yukon's water resources need sound, comprehensive information and well-thought-out strategies to ensure Yukoners have access to the amount and quality of water they will require, well into the future.

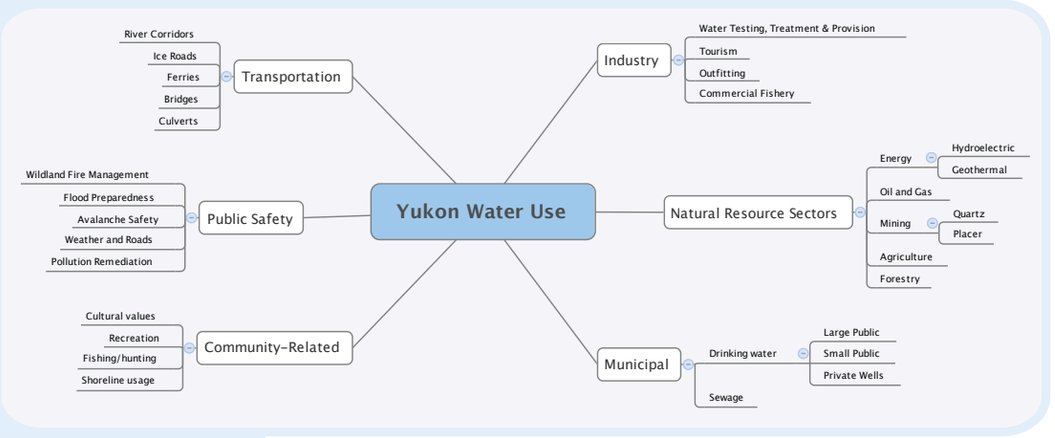


Yukon's water resources, in their many forms, are intertwined in a complex relationship called the hydrologic cycle.

Six major watersheds drain the territory: the Alsek, Yukon, Porcupine, Peel, Liard, and North Slope.

Water is vital to every aspect of Yukon life.

Water use surveys conducted by Environment Canada over the past number of years indicate that Yukoners use consistently more water per person than the average Canadian does for residential use. Our high rate of water use is due in part to the use of bleeders in some buildings to prevent the freezing of pipes. But that's only a fraction of the water we use and need. We rely on the freshwater system to provide a wide range of ecosystem services.



Ecosystem services is a catch-all term for the things water, in its natural setting, does for us. Generally, ecosystem services are broken into four categories:

- Provisioning services: food, water, and basic materials such as wood and fibres.
- Regulating services: controls on climate, flooding, disease, waste disposal, and water quality.
- Cultural services: recreation, plus aesthetic and spiritual benefits.
- Supporting services: natural processes, such as soil formation, nutrient cycling, and photosynthesis.

Water, in the natural ecosystem, plays a vital role in providing all of these services. That means that, as well as planning for our own direct use of water, we need to make sure enough water—and enough good water—stays in the natural system to keep it healthy and intact.

Who Plays a Role

Many people, governments, and agencies have roles to play in some aspect of protecting Yukon water, regulating water use, and planning for the future.

Governments

Yukon Government departments:

- Environment (Water Resources Branch)
- Energy, Mines and Resources (Client Services & Inspections and Minerals Branch)
- Community Services (Community Infrastructure Branch)
- Health and Social Services (Environmental Health Services)
- Executive Council Office (Yukon Water Board secretariat)
- Highways and Public Works (Property Management Agency)

Government of Canada departments:

- Environment
- Indian and Northern Affairs
- Fisheries and Oceans
- Transport

First Nation Governments

Yukon Communities

Boards and Councils

- Yukon Environmental and Socio-economic Assessment BoardYukon Water Board
- Regional Planning Commissions
- Renewable Resources Councils

Non-government organizations and others

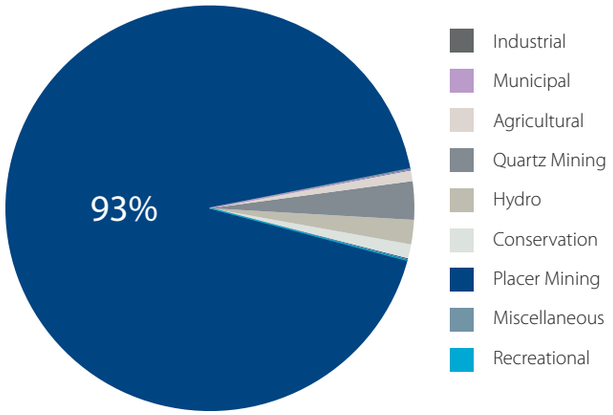
- Yukon River Inter-Tribal Watershed Council
- Yukon Conservation Society
- Yukon Water and Waste Association
- Industry, community organizations, and ordinary citizens

Interjurisdictional initiatives

- Mackenzie River Basin Board
- Canadian Council of Ministers of the Environment
- Council of the Federation Water Stewardship Council

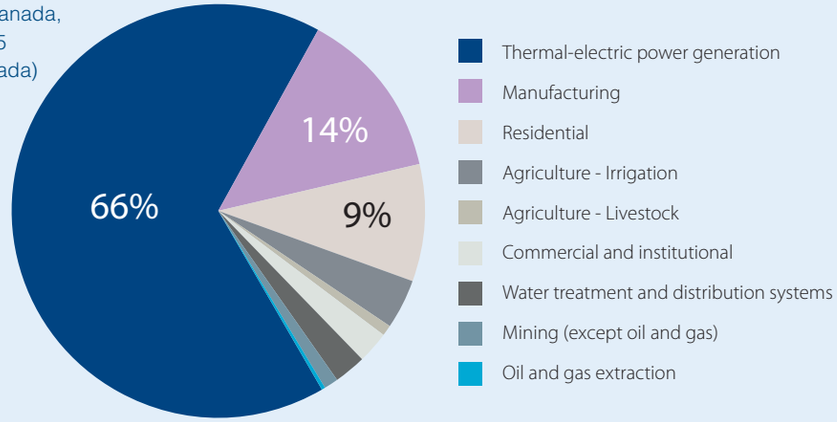
Water Use in Yukon

The Yukon *Waters Act* requires water licences for major water uses. The allowable water use limits set out under those licences provide a broad picture of how water use is divided in Yukon. Mining dominates the allowable licensed use by a substantial margin. In September 2010, placer mining accounted for 93 percent of the gross allowable water use.



Yukon water licence use allowances by licence type percent, September 2010. Licences fall into nine categories: Agricultural, Conservation, Hydro, Industrial, Municipal, Miscellaneous, Placer, Quartz, and Recreational

The National Picture



Water use in Canada, by sector, 2005 (Statistics Canada)

Hydro Power

Hydro power is the main form of electricity production in Yukon, with the scale ranging from the large four-turbine plant at Whitehorse Rapids to small, in-stream micro-hydro installations serving only one user.

Growth

The Yukon Energy Corporation's 2006 20-Year Resource Plan assesses 19 potential hydro project options to meet potential growing energy demand. These options include the expansion of existing facilities and new projects that range in size from very small to very large.

Vulnerabilities

Secure access to water is critical for existing and new hydroelectric power generation. The hydro sector is concerned about extreme events that could affect systems in the future and long-term climate change impacts that could pose threats beyond what has been experienced in the past.

Oil and Gas

Oil and gas operations use water in drilling muds, water flooding to extract oil and gas, and ice roads to gain access to oil and gas wells. Currently, Yukon has two producing wells in the southeast. while many exploration wells have been drilled, mostly in the Liard Plateau, Peel Plateau, or Eagle Plain basins.

Growth

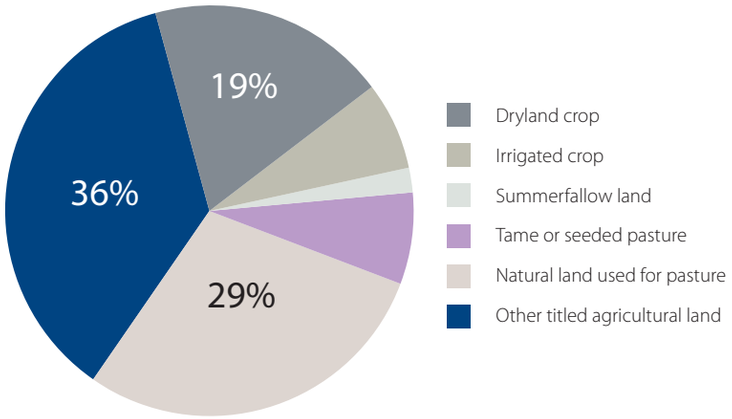
Active exploration is underway in several areas. However, future production depends on the size of reserves, the price of oil, the cost of production, and the cost and accessibility of transportation.

Vulnerabilities

Industry concerns center on the availability of enough water for ice roads in the Eagle Plains area. To this end, the industry has developed best practices to limit water use, in addition to considering summer access where it is an option.

Agriculture

Less than 2 percent of Yukon lands, mainly in the major river valleys, are suitable for agricultural development. Yukon farmers need water for irrigation, crop washing, livestock, and home use. Most agriculture production occurs in southwest Yukon where droughts between April and July are common, so access to irrigation water is important.



Agricultural lands and use types in Yukon (Statistics Canada)

Growth

There is likely to be more demand in the future for local vegetables and locally grown foods, with demand for hay crops remaining strong. One of the biggest constraints on growth is the accessibility of water, and the limited amount of agricultural land adjacent to water courses.

Vulnerabilities

In southwestern Yukon, where drought conditions and constant irrigation are the norm, the integrity of irrigation systems is the largest vulnerability. Changing temperature and precipitation conditions would affect the amount of irrigation water available and the amount required to produce a crop.

Fisheries and Aquaculture

Yukon's freshwater fishery is dominated by recreational angling, with a small component of commercial, domestic, and First Nations fisheries concentrated on lake trout and lake whitefish. Yukon also has a small aquaculture industry composed of pothole-lake fish farms, where fish are stocked and grown in closed-system pothole lakes, and tank farm operations that raise and export Arctic char and Arctic char eggs.

Growth

Although there is room for growth in the freshwater commercial fishery, recreational angling is expected to decline due to lack of participation by youth. Not all fish farm licences issued on pothole lakes are currently active. The existing licensed capacity, combined with tank farms and hatcheries, could produce significant quantities of commercial fish products.

Vulnerabilities

Changing hydrological or water quality conditions caused by climate change could aggravate existing stressors, including the spread of fish diseases and invasive species, as well as stresses on fish habitat from such pressures as residential development, forestry, hydro projects, roads, and mining.

Mining

Hard rock mines (also called quartz mines) and placer mines are currently active in Yukon. Hard rock mines can affect water resources, particularly water quality, during all phases from exploration to closure. The key issue is usually too much water rather than a scarcity of it. The water balance of a mine site, which is an important tool for water management in mining, refers to the need to account for all water in and out of the site. Water is critical to every stage of placer mining. Placer miners excavate soil and gravel, often in streambeds, to uncover the gold-bearing gravels. Water thaws the frozen ground, washes the gold-bearing gravel loose, and sluices the gold free. Other fine materials are washed away, resulting in high concentrations of suspended sediments in the discharge water.

Growth

Considerable growth is projected in the Yukon hard-rock mining sector, with a number of mines currently under development. A sustained high in gold prices could encourage greater frontier exploration in the placer mining sector, but accessibility and meeting sediment discharge standards will continue to challenge the industry.

Vulnerabilities

For the hard rock mining sector, increasing precipitation could make it more difficult to manage water quality. With little baseline data available, it is difficult to assess impacts on the aquatic environment under changing conditions or to incorporate climate change concerns into the design of long-term projects. Climate change could have both positive and negative impacts on Yukon placer mining. Reduced permafrost cover could make mining easier and cheaper, but shorter ice-road seasons could make site access harder and more expensive. Lack of water would halt placer mining altogether.

Forestry

Yukon's forestry sector is small, with only about 70 commercial operators. Most harvest fuelwood for domestic heating, while two operating mills produce rough lumber for local markets. Given the small scale of Yukon forestry, its impact on water resources is limited.

Growth

The Yukon forestry sector's growth is likely limited, given the small interest in the available forest resource. There is potential opportunity in the use of fuels such as wood chips or pellets in central heating.

Vulnerabilities

Climate change might lead to more forest fires and insect disturbances, as well as changes to forest species, which could in turn have dramatic effects on water resources in forested watersheds.

Municipal

Municipal water is used for drinking, cooking, toilets, bathing or showering, laundry, cleaning, and other household needs, including watering lawns and gardens and washing cars. Two thirds of Yukon municipal water supplies go to residential users. More than 97 percent of Yukoners rely on groundwater, about which we currently have very little knowledge.

Growth

Yukon has had small incremental population growth for some years, but an influx of people or a mining boom could have an impact on small communities. Increased tourism could have a large impact on water provision and sewage in some communities. With or without growth, many communities will need to upgrade their water systems in the coming years due to aging infrastructure.

Vulnerabilities

There is significant concern about protecting groundwater from contamination. Some researchers suggest that climate change might already be affecting groundwater supplies. Changing permafrost conditions could pose further threats to the quality of Yukon groundwater. Planners face an additional challenge, in that climate change means they can no longer rely on historical data to predict the future.

How Climate Change Might Affect Yukon's Water Resources

Water is linked inextricably with climate. The warming trend recorded over the past decades shows up in changing precipitation patterns, widespread melting of snow and ice, increases in atmospheric water vapour through increasing evaporation, and changes in soil moisture and runoff. However, it is difficult to pinpoint exactly how climate change is affecting the hydrologic cycle at the Yukon scale, among all the other variables that affect climate or water or both. While there is broad agreement that changes affecting Yukon water resources will occur as a result of climate change, they will vary from region to region.

Here are some of the trends and processes to watch for:

Temperature

In Yukon over the last several decades, winter and summer temperatures have increased in all regions, and the forecast is for continued warming over the coming decades.

Precipitation

Across Canada, annual precipitation increased from 1950 to 1998. All parts of Yukon appeared to experience slightly higher winter precipitation during this period. In summer, precipitation decreased in the north, and increased in the south. Everywhere, more spring precipitation fell as rain and less as snow than in the past. Climate models and trend analyses come up with a variety of predictions for precipitation trends in Yukon. However, they all agree that annual precipitation will go up from 5 to 20 percent by the end of the century.

Snowpack

Snowcover melt and associated floods are the most important hydrologic event of the year in many river basins in Yukon. Winter and early-spring snow depths decreased over much of Canada between 1946 and 1995. Northern Yukon experienced similar decreases, but increases occurred in parts of northern British Columbia. Snowmelt has started earlier in Yukon over recent decades, particularly in mountain streams, and multiple analyses confirm that the period of snow-cover is decreasing across the Arctic. In fact, 2010 set a new record for low spring snow-cover duration. The trend is likely to continue, bringing earlier peak flows to most Yukon river basins.

Evaporation and Evapotranspiration

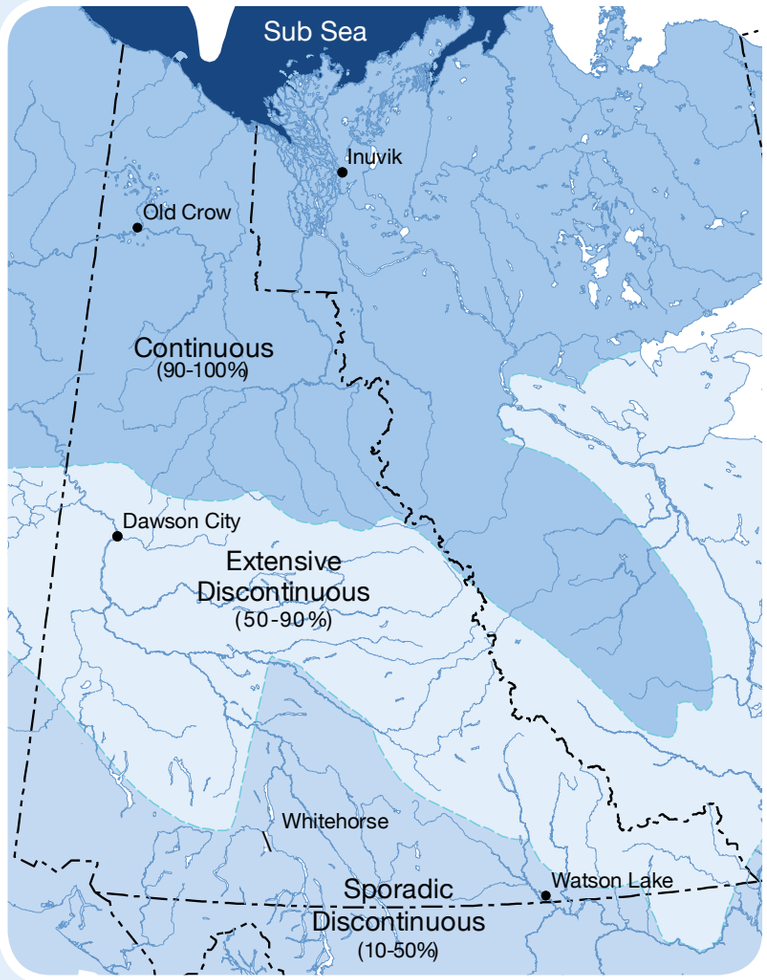
Climate change could have a critical impact on evaporation and, therefore, on water availability. However, the mechanisms that control evaporation are not clearly understood. Increasing temperatures can lead to an increase or a decrease in evaporation, but so can other factors, such as increased cloudiness. An analysis of global evaporation trends under climate change showed that evaporation is likely to increase in high latitudes. A complicating factor is evapotranspiration, the evaporation of water from plant leaves, which is affected by growing conditions and the number and kind of plants, as well as by the direct impact of climate.

Glaciers

The hydrology of much of southwestern Yukon is tied to glaciers, which influence both streamflow and water quality. Changes to glaciers due to general climate change could have a profound influence on the hydrology of Yukon's glacier-dominated basins. In the 50 years between 1958 and 2008, the total ice area in Yukon shrank by 22 percent. Precisely what this kind of change means for Yukon's freshwater resources remains unclear. As glaciers recede, streamflow will decrease, but the decrease might not happen right away. At first, increased glacial meltwaters will likely contribute vagreater flows downstream. If some basins lose their glaciers altogether, the result is likely to be a dramatic shift in streamflow patterns. Glacial melt can also lead to short-term, catastrophic effects, such as the formation of unstable glacial lakes and outburst floods.

Permafrost

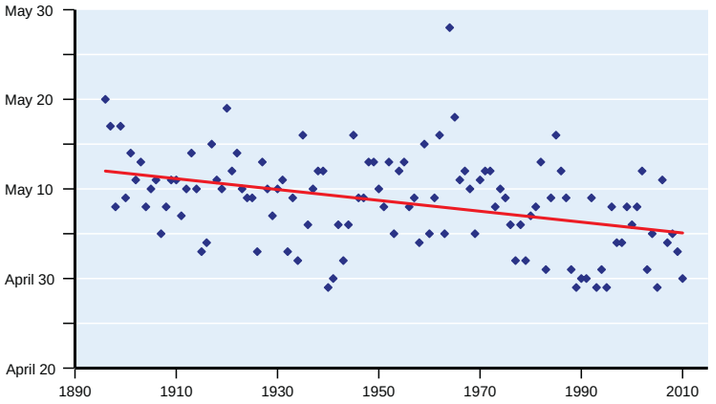
In northern regions, permafrost has a huge impact on local hydrology by determining how far water can penetrate into the ground and, therefore, how quickly it moves downslope. Yukon has three permafrost zones: continuous, discontinuous, and sporadic. Climate change is causing a change in the permafrost distribution, with increasing air temperatures leading to permafrost warming and thawing. The result is a thicker active layer above the permafrost. Permafrost degradation is expected to be greatest within the discontinuous and sporadic zones. Changes in permafrost can lead to shifts in drainage patterns, creation of new ponds and wetlands, changes in water chemistry as groundwater penetrates deeper into the soil, and shifts in the timing of peak and minimum flows.



Yukon has three permafrost zones: continuous, discontinuous, and sporadic.

River Ice

River ice is important in cold regions. Frozen rivers are used for transportation, and river ice serves as a platform for fishing and trapping. Freeze-up and break-up can produce ice jams that result in flooding. Ice jams and related processes also affect aquatic ecosystems. If the river ice break-up coincides with the spring freshet, chances of serious flooding increase. Break-up dates for the Yukon River at Dawson since 1896 show that the break-up date advanced by 5 days over the last century, and even faster in the last two decades.



Yukon River at Dawson break-up dates (1896-2010)

Less is known about complex variables related to river ice, such as ice-cover thickness or ice jams, but Yukon might already be experiencing related changes. In 2003, a midwinter break-up and associated ice jam occurred on the Klondike River at Dawson, flooding parts of the community. The event was triggered by record high air temperatures and rainfall, perhaps a direct result of climate warming.

Streamflow

Yukon streams belong to four hydrologic response types: Glacial, Interior, Northern, and Arctic. All are shaped by different conditions, exhibit different streamflow patterns, and show different patterns of response to changes in climate. One broad study, based on a large suite of climate models, predicts increased river flow in the Yukon, Mackenzie, and other northern rivers through the 21st century. A smaller-scale study suggested that, over the same period, annual inflows to the glacierized upper Yukon River would increase by 39 percent, mainly in summer, due to increasing temperature and precipitation. The degree and direction of future changes remain far from certain and are under active research.

Groundwater

Groundwater is water located in the spaces between soil particles and in the fractures of rock formations underground. How climate change will affect groundwater is not well understood. However, the impacts are important. Most of Yukon's municipal water supply comes from groundwater, and late-winter streamflow in Yukon consists almost entirely of groundwater. Climate change could affect the amount of groundwater available and the timing of groundwater flow through changes in precipitation, melt timing, and permafrost thawing, which deepens the active layer and changes the conditions for underground storage and movement of water. Trends in streamflow investigated over 20 to 50 year periods in the Yukon River Basin showed significant increases in estimated groundwater flow. In Yukon, the largest increases in estimated groundwater inputs were detected in the Yukon River headwaters and in the Porcupine River watershed.

Water Quality

Changes in the quantity and temperature of water resources will lead inevitably to changes in water quality. Lower water levels tend to increase concentrations of ions (e.g., dissolved metals) in water. High flows and flooding flush sediment and contaminants, both natural and anthropogenic, into the water system. Higher water temperatures affect ecosystems, human health, and the reliability and costs of water systems. The complexity of a hydrologic system makes it difficult to predict the impacts of climate change, especially in the North where the cryosphere—snow, ice, and permafrost—is an integral part of the system and a complicating factor.

Extreme Events

A standard prediction associated with climate change is an increase in extreme events. Since precipitation is influenced by climatic oscillations, particularly decadal variations, it is difficult to identify trends in extreme precipitation events related to global climate change and equally hard to predict them. However, there appears to be an upward trend in the number of heavy snowfall events for autumn and winter over northern Canada, with no change in intense precipitation events. Other extreme events, probably related to climate change, are already making themselves felt. A mid-winter flood in Dawson in 2002-2003 appears to have been triggered by record-high temperatures and the unusual phenomenon of December rainfall. In 2007, two thermokarst lakes in Old Crow Flats drained catastrophically, apparently as a result of decaying permafrost on their margins. That same year, flooding in the Southern Lakes, the result of heightened glacial melt in a hot summer and summer precipitation, caused extensive property damage.

Yukon Monitoring Networks

Who's monitoring Yukon water resources?

Government of Yukon
Government of Canada
United States Geological Survey
Yukon First Nation Governments
Yukon River Inter-Tribal Watershed Council
Universities
Co-management agencies
Industry

For more information about these networks and links to available data, go to yukonwater.ca.

Hydrology Networks

Name: Canada-Yukon Hydrometric Monitoring Network

Agency: Water Survey of Canada, Environment Canada

Other agencies involved: Water Resources Branch, Environment Yukon

Program objectives: To provide Yukon hydrometric information as part of a national framework for hydrometric monitoring.

Parameters measured: Water level and/or streamflow discharge recorded at all stations. Sediment (sediment concentration and loading) recorded at 12 stations (1968-1992). Other parameters such as river width, depth, velocity, water temperature, ice thickness, river conditions, and pictures are collected during site visits.

Period of record: 1940s to present.

Name: Yukon Hydrometric Network

Agency: Water Resources Branch, Environment Yukon

Program objectives: To collect long-term hydrometric data on small drainage basins (<500 km2) and provide baseline information for future developments (e.g., culverts, fisheries concerns, gas pipelines, hydroelectric, and quartz and placer mining developments).

Parameters measured: Water level, streamflow discharge.

Period of record: 1974 to present.

Name: Canadian Meteorological Network

Agency: Meteorological Service of Canada, Environment Canada

Program objectives: To collect meteorological information.

Parameters measured: Wind speed and direction, temperature, barometric pressure, precipitation amount and type, and humidity. Some stations monitor lightning strikes, cloud type and height, and pressure aloft.

Period of record: 1920s to present.

Name: Community Services Weather Network

Agency: Wildland Fire Management Program, Yukon Community Services

Program objectives: To monitor and predict the daily fire danger rating for Yukon during the forest fire season.

Parameters measured: Relative humidity, wind speed and direction, temperature, precipitation monitored continuously.

Period of record: 1993 to present.

Name: Yukon Meteorological Network

Agency: Water Resources Branch, Environment Yukon

Program objectives: To collect meteorological data in support of the Yukon Streamflow Forecasting Program.

Parameters measured: Air temperature, precipitation, relative humidity, wind speed and direction, solar radiation, and barometric pressure. Additionally, soil heat flux, air-snow interface temperature, infrared canopy temperature, soil temperature, snow depth, and soil moisture, incoming and outgoing short wave radiation and net radiation and blowing snow rate are measured at the Wolf Creek meteorological stations.

Period of record: 1993 to present.

Name: Yukon Snow Survey Network

Agency: Water Resources Branch, Environment Yukon

Other agencies involved: Field collection assistance from Client Service and Inspections Branch, Yukon Energy Mines and Resources; British Columbia Ministry of Environment, Water Stewardship Division; USDA Natural Resources Conservation Service; Yukon Highways and Public Works; Parks Canada; Yukon Energy Corporation; and private contractors.

Program objectives: To collect snow water equivalent data for runoff forecasting, as well as to assist in planning and design of development projects, wildlife studies, avalanche forecasting, highway maintenance, forest fire indexing, and building design.

Parameters measured: Snow depth, snow water equivalent, density. The number reported is an average of 10 samples.

Period of record: 1975 to present.

Name: Yukon River Ice Break-up at Dawson City Monitoring

Agency: Water Resources Branch, Environment Yukon

Other agencies involved: The Imperial Order of the Daughters of the Empire.

Program objectives: To track the date of ice break-up on the Yukon River at Dawson.

Parameters measured: Date of ice break-up.

Period of record: 1896 to present.

Name: Yukon-wide Long-term Groundwater Monitoring Program

Agency: Water Resources Branch, Environment Yukon

Program objectives: To collect information on long-term trends in groundwater in areas where there is infrastructure (e.g., country residential sub-divisions).

Parameters measured: Depth to groundwater.

Period of record: 2001 to present for Wolf Creek well; 2008 to present for others.

Name: Yukon Water Well Registry

Agency: Water Resources Branch, Environment Yukon

Other agencies involved: Natural Resources Canada

Program objectives: To improve knowledge of the characteristics of groundwater aquifers in the Yukon through information from the development of groundwater wells.

Parameters measured: One-time record of well construction details; nature of overburden and bedrock; groundwater levels and characterization.

Period of record: Earliest record is 1963.

Water Quality Networks

Name: Canada-Yukon Water Quality Monitoring Program

Agency: Environment Canada – Pacific & Yukon Region

Other agencies involved: Water Resources Branch, Environment Yukon; Parks Canada; Vuntut Gwitchin First Nation

Program objectives: To provide information to assess long-term trends in water quality.

Parameters measured: Acid/base chemistry, carbon, carbon-nitrogen compounds, major ions, metals, dissolved non-metals, nutrients, organic contaminants, oxygen, pathogens. Most stations are sampled every month.

Period of record: 1983 to present.

Name: Yukon River Water Quality Monitoring Project

Agency: Yukon River Inter-Tribal Watershed Council

Other agencies involved: United States Geological Survey; Environment Yukon; Environment Canada

Program objectives: To provide a better understanding of variations in water quality as the Yukon River flows from Canadian headwaters to the Bering Sea.

Parameters measured: pH, temperature, conductivity, dissolved oxygen recorded in field. Dissolved gas, major ions, nutrients, oxygen 18, and dissolved organic carbon content analyses conducted in laboratory.

Period of record: 2004 to present.

Name: Water Licence Water Quality Reporting and Audits

Agency: Water Resources Branch, Environment Yukon

Program objectives: To monitor and audit licensee compliance with the conditions of water licences issued by the Yukon Water Board, where licence activities pose a potential threat to water resources.

Parameters measured: Licence-dependent, but typically water chemistry (total or dissolved metals).

Period of record: 1970s to present.

Name: Environment Canada Water Quality Baseline and Audit Repository

Agency: Environmental Protection Operations Directorate, Environment Canada

Program objectives: To collect and manage water quality data for analysis and standardized information archival.

Parameters measured: Extensive (varies by site).

Period of record: 1990s to present.

Name: Placer Water Quality Objectives Monitoring

Agency: Client Services and Inspections Branch, Yukon Energy, Mines and Resources

Program objectives: To monitor water quality under the Fish Habitat Management System for Yukon Placer Mining.

Parameters measured: Total suspended solids, settleable solids, turbidity, and conductivity; pH; air and water temperature at all stations. Streamflow and water chemistry, including metals and nutrients, at some stations. Continuous air, ground, and water temperature, along with precipitation at sites with portable weather stations.

Period of record: 1992-2007, water quality. 2008-present, water quality and meteorological parameters.

Name: Water Quality Monitoring at Type II Abandoned Mines without Water Licences

Agency: Assessment and Abandoned Mines Branch, Yukon Energy, Mines and Resources

Other agencies involved: Private contractors

Program objectives: To monitor water quantity and quality at Type II Abandoned Mines.

Parameters measured: Flows, contaminants (heavy metals, arsenic, cyanide, suspended solids). Each site also has a weather station.

Period of record: Varies by site, approximately 10 years.

Name: Metal Mining Effluent Regulations Reporting Requirements

Agency: Environment Canada

Program objectives: To monitor effluent discharges from mines under the federal Metal Mining Effluent Regulations.

Parameters measured: Deleterious substances (arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, and radium 226) and pH; acute lethality tests and Daphnia magna tests; EEM data (effluent characterization, water quality monitoring, and sublethal toxicity testing). Biological monitoring data are submitted to the National Environmental Effects Monitoring Office of Environment Canada.

Period of record: 2006 to present for Yukon sites.

Name: Drinking Water Bacteriological Testing

Agency: Environmental Health Services,
Yukon Health and Social Services

Program objectives: To provide an accredited laboratory for testing total coliforms and E. coli at no cost to drinking water operators and private owners.

Parameters measured: Total coliforms and E. coli.

Period of record: 1997 to present.

Name: Property Management Drinking Water Database

Agency: Property Management Division,
Yukon Highways and Public Works

Program objectives: To maintain bacteriological water quality information for all Yukon government-owned buildings not served by a public drinking water system.

Parameters measured: Bacteriological, physical, and chemical water quality.

Period of record: 2004 to present.

Name: Community Services Drinking Water Database

Agency: Community Development Division,
Yukon Community Services

Program objectives: To provide safe drinking water for public drinking water systems operated by Community Services in unincorporated communities.

Parameters measured: Bacteriological, physical, and chemical water quality parameters.

Period of record: 1990s to present.

Name: Groundwater and Surface Water Monitoring at Yukon Contaminated Sites

Agency: Environmental Programs
Branch, Environment Yukon

Program objectives: To monitor groundwater and surface water at contaminated sites in Yukon, under the *Environment Act* 's Contaminated Sites Regulation.

Parameters measured: Wide variety of information about contaminated sites.

Period of record: N/A

Name: Solid Waste Disposal Facilities Permitee Monitoring for Leachate Impacts

Agency: Environmental Programs
Branch, Environment Yukon

Program objectives: To monitor permit requirements for dumps and landfills in the Yukon, as required under the Environment Act Solid Waste Regulations.

Parameters measured: Water chemistry; varies by site.

Period of record: 2001 to present for Whitehorse; more recent for other sites.

Ecosystem Health Networks

Name: Biomonitoring Information System of the Yukon

Agency: Environment Canada

Program objectives: To collect aquatic biological data and gather historical data and information from published and unpublished sources.

Parameters measured: Freshwater benthic invertebrates (regardless of methodology), stream sediment chemistry, in situ stream measurements, geo-reference information, habitat, specimen photographs, site photographs, short video clips, and water chemistry (varies by site).

Period of record: 1973 to present; water chemistry 2002 to present.

Name: Canadian Aquatic Biomonitoring Network

Agency: Environment Canada

Program objectives: To support a network of networks through a shared online database where information on the biological health of freshwater systems in Canada can be stored and analyzed.

by all network users..

Parameters measured: Benthic invertebrate communities, physical and chemical habitat parameters.

Period of record: Early 2000s to present.

Name: Yukon Government Fisheries Database

Agency: Fish and Wildlife Branch, Environment Yukon

Program objectives: To document and track fisheries-related data collected by Environment Yukon.

Parameters measured: Fish presence, fish species, biological characteristics of fish, reports, physical and chemical data, where available.

Period of record: 1990s to present.

Name: Ecological Monitoring of Freshwater Thermal Regimes

Agency: Ta'an Kwäch'än Council

Program objectives: To develop series data on water temperature in the Yukon River and its tributaries within Ta'an traditional territory in order to monitor impacts of climate change, with specific focus on chinook salmon migration and spawning.

Parameters measured: Water temperature within 0.2°C, every hour.

Period of record: 2010 to present

Name: Monitoring of Freshwater Thermal, Chemical & Biological Regimes of Salmon Migration Habitat

Agency: Tr'ondëk Hwëch'in

Program objectives: To collect baseline data on climate-linked variables related to traditional food security.

Parameters measured: Water temperature (within 0.2°C every hour), pH, turbidity, conductivity, dissolved oxygen, total dissolved solids, nutrients and metals.

Period of record: 2010 to present

Name: Michie Creek Monitoring Project

Agency: Kwanlin Dün First Nation, Yukon River Panel

Program objectives: To develop series data on chinook salmon response to annual fluctuations in water temperature and flow at the Michie Creek chinook spawning site.

Parameters measured: Adult chinook salmon and redd enumeration, juvenile salmon abundance, freshwater benthic invertebrates , water temperature and flow.

Period of record: 2003 to present

Where to Go from Here

Yukoners have many water needs. Our natural resource sectors draw, divert, and alter water from major rivers, small creeks, and groundwater sources. Some industries, such as agriculture and placer mining, depend entirely on the availability of water for successful operation. Hydro power plants depend on reliable river flows, as well as water storage, in order to meet energy demands. Quartz mines often have too much water and have to manage it carefully to minimize impacts on surrounding water quality. Groundwater is the main source of drinking water in most communities. We also use water bodies and waterways for travel, firefighting, recreation, harvesting, and cultural purposes.

The National Round Table on the Environment and the Economy has flagged the need for accurate, reliable data on water use by resource sectors. In Yukon, we have some data, but we're not using it to its full capacity. Annual water use data is collected through water licences but the information has not been assessed by undertakings, sector, or on a watershed basis, due in part to relatively low pressures in most large watersheds.

Water Monitoring for Climate Change

Many governments, departments, and organizations are engaged in water monitoring and data collection in Yukon. Most of the data are publicly available. However, many of the networks are largely unknown outside their discipline or sector. While most of these programs are not collecting data for the purpose of climate change detection and adaptation monitoring, their coverage is invaluable to climate change planning. Data collection programs specifically related to climate change have been initiated in recent years in response to adaptation concerns. While these are valuable, the continuation of existing long-term water monitoring networks is paramount to trend analysis and modeling.

Monitoring data and information collected by universities, community organizations, and the private sector are not included in this inventory, given their often limited public availability. Nevertheless, they represent another valuable subset of data that could benefit climate change adaptation planning.

A high-level investigation of the spatial coverage of existing networks revealed some important gaps. Hydrometric, meteorological, and snow networks provide good regional coverage in the territory, but there is a large gap in the coverage of water quality in northern Yukon, with no active stations in the Peel Watershed.

Possible Areas for Further Consideration

Much work remains in order to address the vulnerabilities of Yukon water resources to climate change. Here are a number of ways we might focus our attention:

- Monitor and manage on a watershed basis, rather than stream by stream.
- Incorporate water valuation principles and a more formalized approach to environmental flow assessments into water management.
- Consider projected hydrologic changes in near- and long-term planning for hydro power production.
- Take future changes to water flow and quality into account when assessing future agriculture growth areas, and associated water supply options.
- Revisit minesite water balance and water management plans regularly to ensure they respond to climate and hydrologic changes.
- Consider climate change implications for mine closure planning, including on-going monitoring.
- Develop community risk evaluations and adaptive management plans for the water needs of Yukon communities.
- Learn more about groundwater resources, and ensure the information is communicated from researchers and monitoring agencies to decision makers.
- Review and adjust water monitoring networks to take into consideration future needs, climate change, and adaptation measures.
- Support watershed modelling research that could help decision makers ensure projects affecting water are sustainable.
- Increase dissemination of water monitoring data and information.
- Review water management, continually, to ensure that decision making is informed by and responsive to changing climatic conditions.

TAKING ACTION ON CLIMATE CHANGE

Yukon
Environment