NWT SNOW SURVEY BULLETIN AND SPRING WATER LEVEL OUTLOOK

2022

Government of
Northwest Territories

Overview

This is an outlook for anticipated 2022 spring water levels in the NWT. Current water levels across the territory are generally average to above average but are variable depending on location and size of waterbody. Snowfall across the territory in the winter of 2021-22 was extremely variable with very low snowfall in the North Slave region and very high snowfall in the Dehcho region. Other regions ranged between average and above average snowfall, based on late March/early April snow surveys conducted by the Government of the Northwest Territories (GNWT). In general, winter temperatures across the NWT were colder than normal which has led to a thicker ice cover than usual. The GNWT is encouraging residents in flood prone communities to prepare for potential flooding.

Flooding in the NWT

Flooding occurred in five NWT communities during the Spring of 2021, where ice-jam conditions were exacerbated by pre-existing high water levels. Although ice-jam flooding can happen in any year, the potential severity of flooding, if an ice-jam occurs, can increase when water levels are higher. The occurrence of ice-jams is heavily dependent on weather conditions just prior to and during break up (how much and how quickly snowmelt water reaches river systems, and how the ice breaks up) but also to a lesser extent over-winter conditions (e.g., snowfall, ice thickness, temperatures). As always, it is difficult to predict in advance how break up will occur in any given year.

Ice-jams typically form on north-flowing rivers, where warm weather and snowmelt cause ice to break up on the southern reaches of a river. As this ice flows north (downstream), it meets a more solid ice cover. When this happens, the pieces of floating ice run into the solid ice and can form a dam, which causes water levels to rise rapidly.

Sources of information

The GNWT relies on information from various sources, including snow and water level information from our neighbouring jurisdictions, to provide situational awareness about current conditions and how break up is progressing. These data include winter snow data, over-winter temperatures, winter water level and flow data, near real-time water level and flow data (always provisional), near real-time photographs of water levels and ice from cameras at water level gauge sites, near real-time interpreted satellite imagery of ice conditions, forecasted weather conditions, and reports from community flood watch programs.

To determine the volume of water in the NWT that will feed into rivers during spring melt, the GNWT conducted on-the-ground snow surveys from mid-March through early April. These surveys measure the volume of water that is produced when a snowpack melts. This value is

referred to as snow water equivalent (SWE). SWE varies based on the depth of snow and its density. SWE is an important piece of information to look at when anticipating spring water levels, however a high snowpack alone does not necessarily lead to high water levels. The amount of water stored in the soil, wetlands and lakes in the fall impacts how much 'room' there is for absorbing snowmelt water before it reaches streams and rivers. The timing of snowmelt is also very important as a quick, sudden snowmelt will cause a larger spike in water levels than a prolonged snowmelt season.

Assessments of conditions by region

North Slave

The GNWT snow surveys show that the snowpack in the Yellowknife and Snare River basins are well below average amounts at 75% of normal as of early April 2021.

Provisional flows on gauged rivers around Yellowknife (e.g., Cameron, Yellowknife, Baker) are approximately average and fluctuated between average and above average during the summer/fall of 2021. Flows on rivers draining into the East Arm of Great Slave Lake (e.g., Lockhart, Hoarfrost, Waldron) were much higher than average (highest on record in some cases) during the summer/fall of 2021 and have remained high over winter. Flows on rivers north of Yellowknife (e.g., Snare, Coppermine) were above average in the summer/fall of 2021 and are approximately average this spring. **Water levels on Great Slave Lake remain high but have receded slightly from the extreme levels experienced in the summer of 2020 and spring of 2021.** Low snowpack values in the North Slave region will likely result in lower flows on local rivers but will not have a strong impact on water levels on Great Slave Lake as the vast majority (~75-80%) of the water in Great Slave Lake comes from the Slave River to the south.

Slave River Basin

The primary tributaries to the Slave River basin are the Peace River, Athabasca River and Lake Athabasca/Peace-Athabasca Delta region. As a result, the GNWT relies on snow survey data from other jurisdictions to assess the snowpack in the basin. SWE values in the headwaters of the Peace River basin in British Columbia were about average at 94% of normal but shift to much above average (170% of normal) towards the Peace-Athabasca Delta. SWE values in the upper Athabasca region are extremely high at 195% of normal. Alberta Environment and Parks has declared that long lead indicators (i.e., SWE, winter temperatures, ice thickness) show an above average potential for flooding along the Athabasca River at Fort McMurray, but that the weather experienced between the date of issue (Apr 06, 2022) and break up will have a large impact on flood risk. Further north, the GNWT snow surveys in the South Slave region found that snowpack was slightly higher than average at 120% of normal.

Flow rates on the Slave River have fluctuated around average for the summer/fall of 2021 and through the winter of 2022. Flow rates on the Peace River have also been about average, while flows on the Athabasca River were below average last summer/fall and through the current winter, although they have started to increase in response to snowmelt. Water levels on Lake Athabasca have dropped since summer 2021 and are still above average.

Taltson and Tazin River Basins

The GNWT snow surveys in the Taltson River basin show that SWE values are approximately average at 92% of normal. Flows on the Taltson and Tazin rivers were at record highs throughout the summer of 2021 but have since receded. Flows are still above average on both rivers, but are approximately half of what they were last year at this time. According to the Water Security Agency of Saskatchewan, near normal runoff is expected over the entire Lake Athabasca basin this spring.

Hay River Basin

GNWT snow surveys show that the snowpack in the northern Hay River basin is higher than average at about 132% of normal as of late March 2021. Most of the land that contributes to the Hay River is in Alberta and British Columbia where snowpack has been reported at 140% of normal, although snow survey sites are sparse in these regions.

The Hay River basin experienced very high rainfall in the summer and fall of 2021, suggesting that the basin is very 'full' and there is limited room for the ground to hold snowmelt water. This means that most of the snow will runoff directly to streams and rivers. Provisional water levels on the Hay River were the highest on record throughout the fall of 2021 and are currently the highest on record for this time of year in the spring of 2022. **We anticipate that high water levels will continue in the Hay River throughout the spring and early summer of 2022 and there is potential for ice related break up flooding.** The weather experienced in the Hay River basin will have a large impact on the flood risk at break up.

For the Hay River watershed, the April 1st spring runoff outlook of Alberta Environment and Parks estimates an above average range (115-150% of normal) for runoff in parts of the upper Hay River basin, but they note that there are insufficient data to provide an outlook for most of the far northern section of Alberta.

Dehcho and Sahtu Regions

In the Liard River basin, Government of Yukon SWE data for April 1st indicate that the snowpack in the upper Liard basin is extremely high at 176% of normal, and at some locations is the highest on record. Further downstream, snow surveys by the Government of British Columbia show that the snowpack is approximately average (109% of normal), while GNWT snow survey data in the lower Liard basin in show high SWE values at 156% of normal. Flows on the Liard River are

currently about average and have been that way since summer 2021. **Flows and levels on the Liard River could increase quickly with a rapid onset of warm weather (and/or rain on snow events), especially if it occurs in the regions where the snowpack is high**.

GNWT snow surveys in the remainder of the Dehcho region indicate that snowpack in the region is extremely high at 168% of normal. Further north, GNWT snow surveys in the Sahtu region found that SWE values are above average at 123% of normal. Prior to the flooding events in 2021, water levels and flow rates on the Mackenzie River were the highest on record. Currently, water levels on the Mackenzie River are much lower than last year but are still higher than average. **Given colder temperatures this winter, higher snowpack volumes in the basin and that water levels on the Mackenzie River and Great Slave Lake are higher than average, there is potential for ice-jam related flooding along the Mackenzie River.** The weather experienced in the Liard and Upper Mackenzie river basins will have a large impact on the flood risk at break up.

Peel River Basin and Beaufort Delta Region

The Government of Yukon snow survey data for the upper Peel River basin for April 1st shows that SWE values are very high at 149% of normal. GNWT snow surveys in the lower Peel and Inuvik region show that snowpack is higher than average at 122% of normal. Flow rates on the Peel River at Canyon Creek (YT) were about average last summer and fall and are currently below average. Real time water levels on the Peel River at Fort McPherson are currently unavailable, but a site visit and measurement on Mar. 16 indicated levels just above average. Water levels on the Mackenzie River at Tsiigehtchic and throughout the Mackenzie Delta are above average for this time of year but are lower than last year when they were record high. **The higher-than-average water levels in the Mackenzie Delta at Aklavik mean that flooding could occur, but because deltaic landscapes have little relief and there are many pathways for water and ice, spring flooding is very dependent on how the ice breaks up and if and where ice-jams occur.**

Factors to watch during break-up

The potential and severity of freshet flooding will depend in large part on the weather over the upcoming weeks and how quickly the snow and ice melt. The following variables are the primary factors that influence water levels and if there will be flooding:

- Rate of snow melt
    - Slow and steady onset of warm weather allow a progressive snowmelt and slow delivery of meltwater to the river network
    - Sudden extreme warm weather can cause a rapid snowmelt which can cause spikes in water levels
    - Rain on snow events can cause rapid snowmelt and can lead to spikes in water levels

- Rate of ice melt/break up
    - Gradually warming weather across an entire basin allows ice to slowly degrade and melt (thermal break up)
    - Very warm weather in upstream areas can cause rapid snow melt and local ice break up. If this ice flows downstream to a solid ice cover, the force of the ice causes downstream ice to break up and can lead to ice-jams (mechanical break up)
- Existing water levels in lakes, rivers, wetlands, and soil
- Snowpack volumes (snow water equivalent)
- Temperatures over the winter
- Whether ice-jams form (primary cause of spring flooding)
    - They can result in the back-up of large amounts of water and can cause flooding (even when water levels are low)
    - Combined with existing high water levels can produce severe flooding scenarios

Water level data are part of the NWT Hydrometric Monitoring Network, funded by Environment and Climate Change Canada (ECCC) and the GNWT, and operated by the Water Survey of Canada. Data can be seen and/or downloaded at: https://wateroffice.ec.gc.ca/search/searchRealTime_e.html.

All real time data are provisional.

Appendix A: Snow survey data for Spring 2022

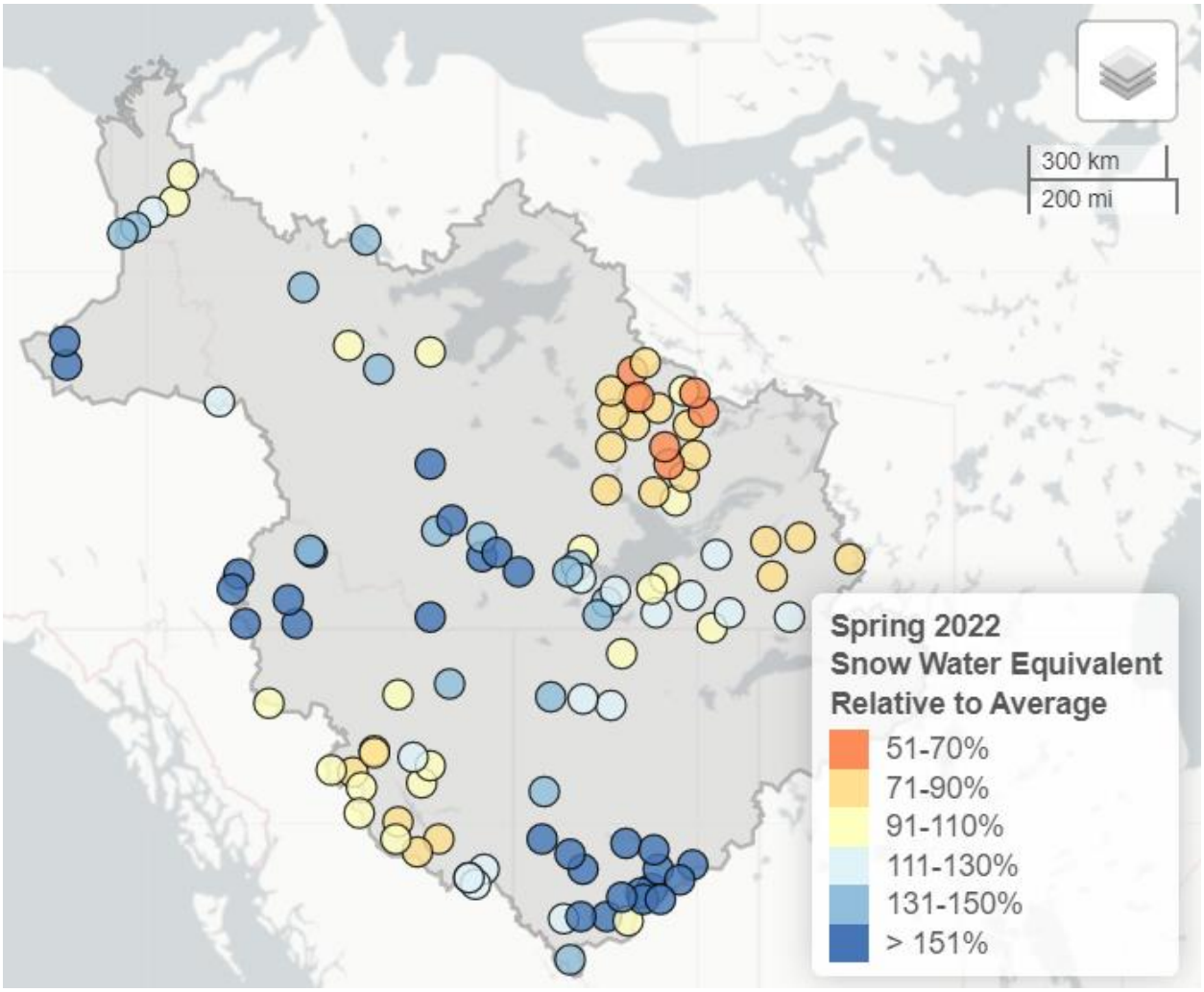


Figure 1: Map of snow water equivalent (SWE) distribution in the Mackenzie River basin.

Data from this map were compiled from the GNWT snow surveys (NWT) as well as snow survey data from neighbouring jurisdictions (Yukon, British Columbia, and Alberta). An interactive version of this map can be found here.

Table 1: NWT snow survey data summary for Spring 2022:

Region	Average Depth (cm)	Average SWE (mm)	SWE (% of normal)
Yellowknife River Basin	45	72	75
Snare River Basin	45	81	75
South Slave Region	67	129	120
Taltson River Basin	56	101	92
Dehcho Region	78	151	168
Sahtu Region	61	119	123
Inuvik/Gwich'in Region	74	138	122

Appendix C: Provisional water level and flow (as of April 21st, 2022)

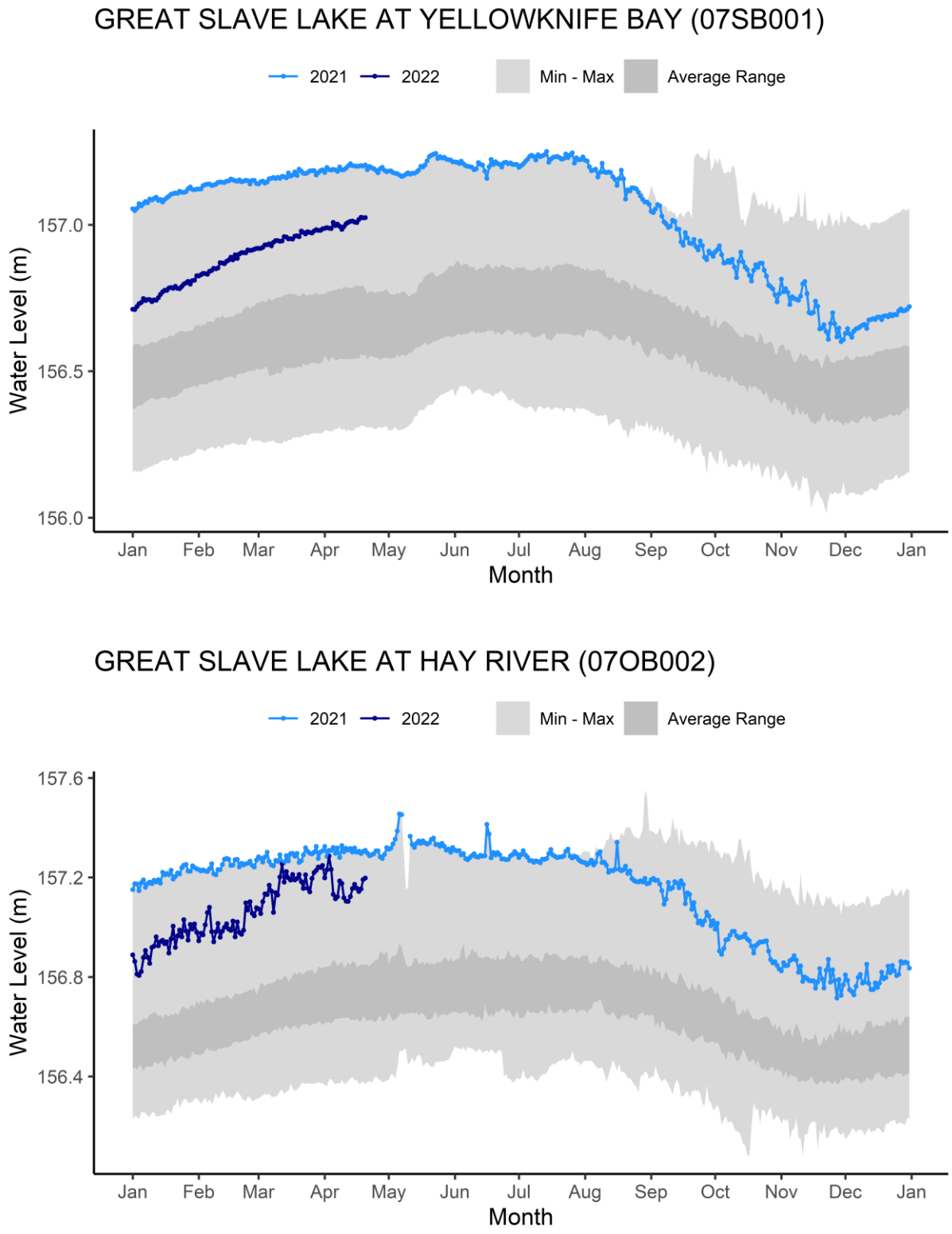
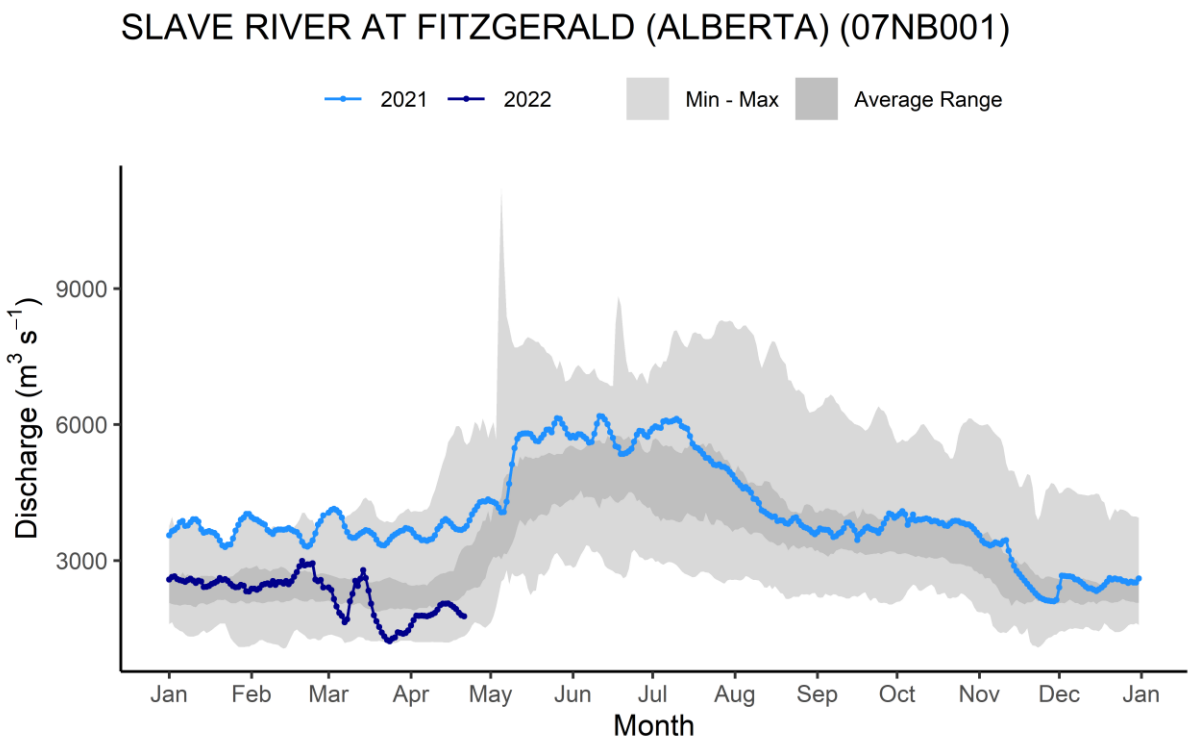


Figure 1: Water levels on Great Slave Lake for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums at: a) Yellowknife Bay; and b) Hay River



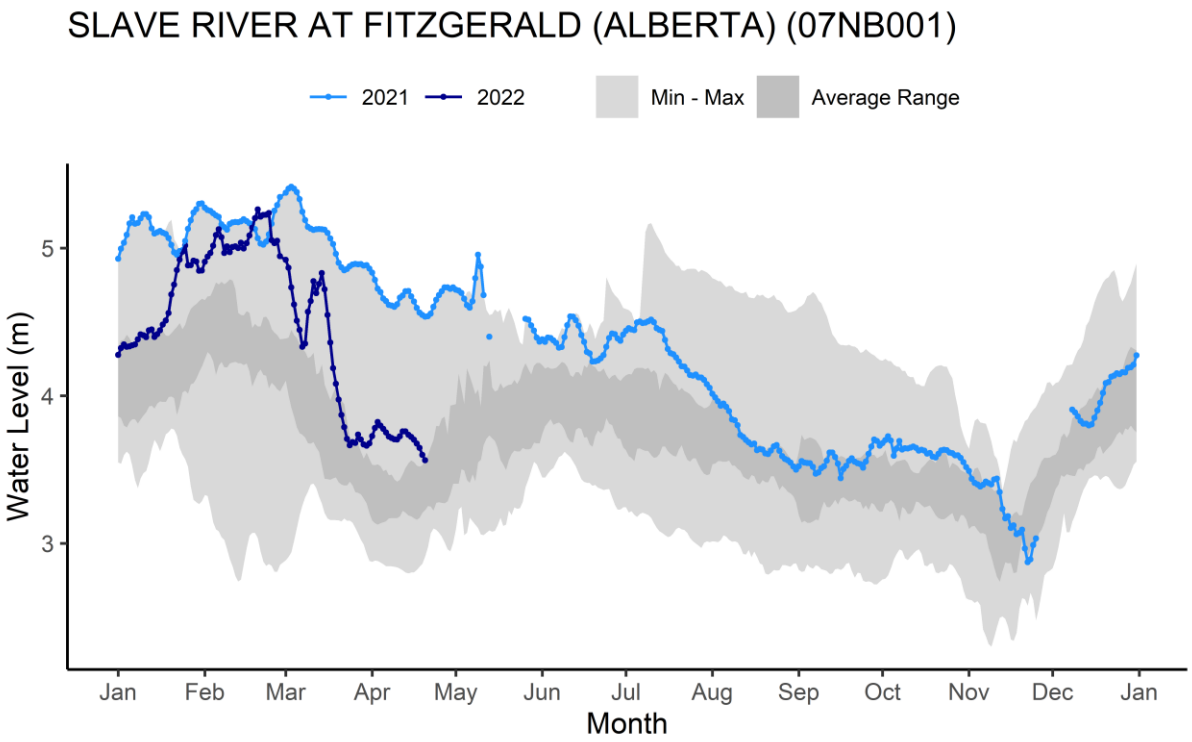


Figure 2: Water flows and levels on the Slave River at Fitzgerald for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums

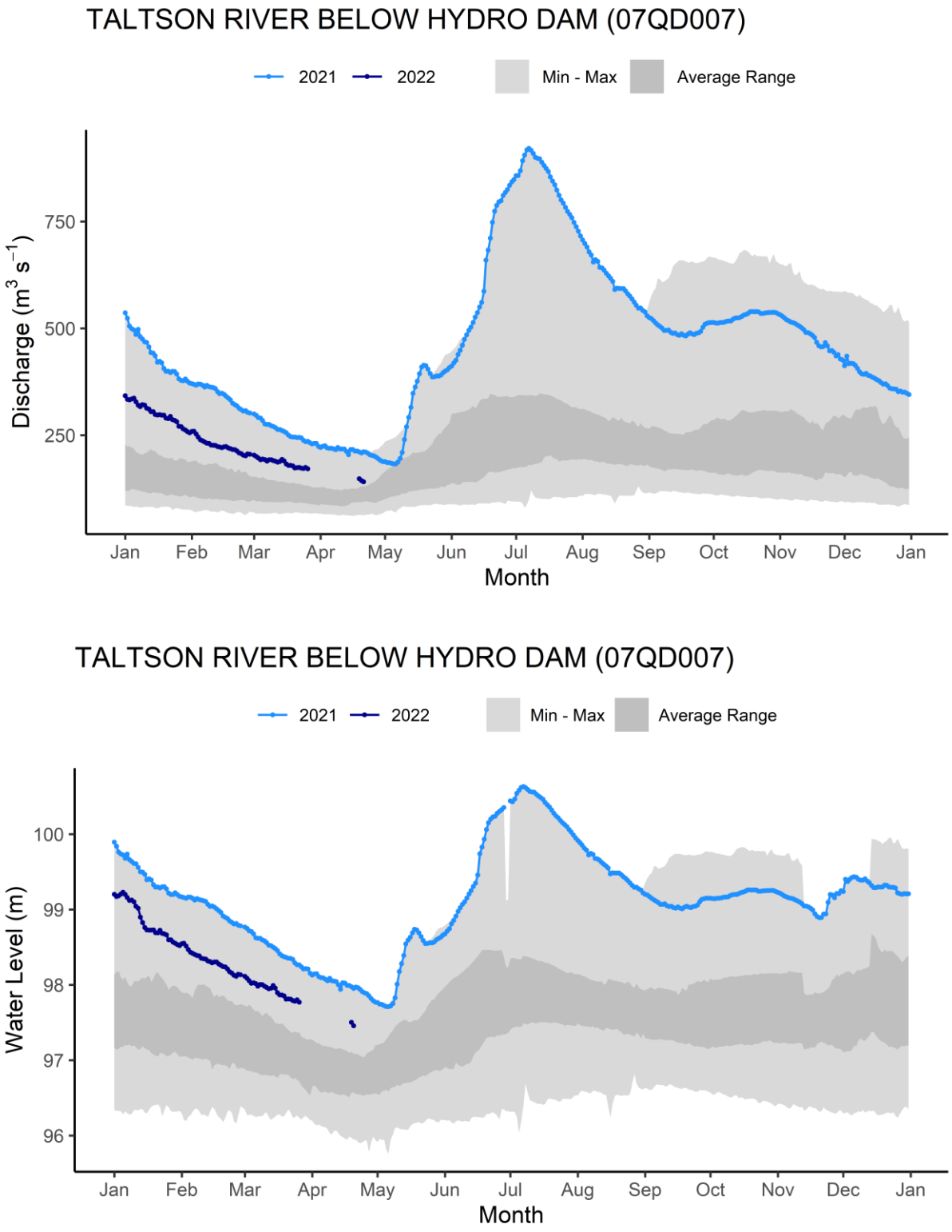


Figure 3: Water flows and levels on the Taltson River for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums

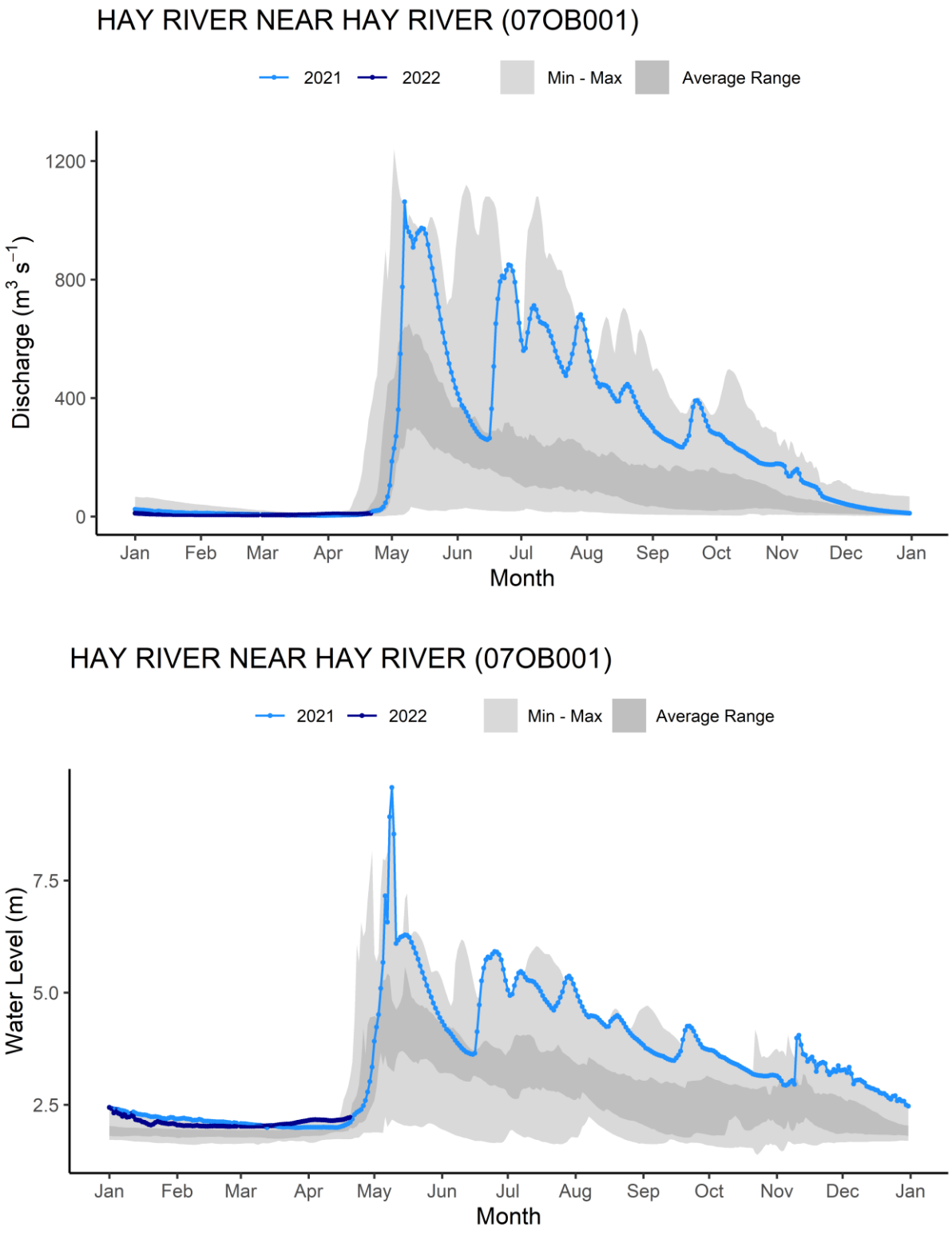


Figure 4: Water flows and levels on the Hay River near Hay River for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums

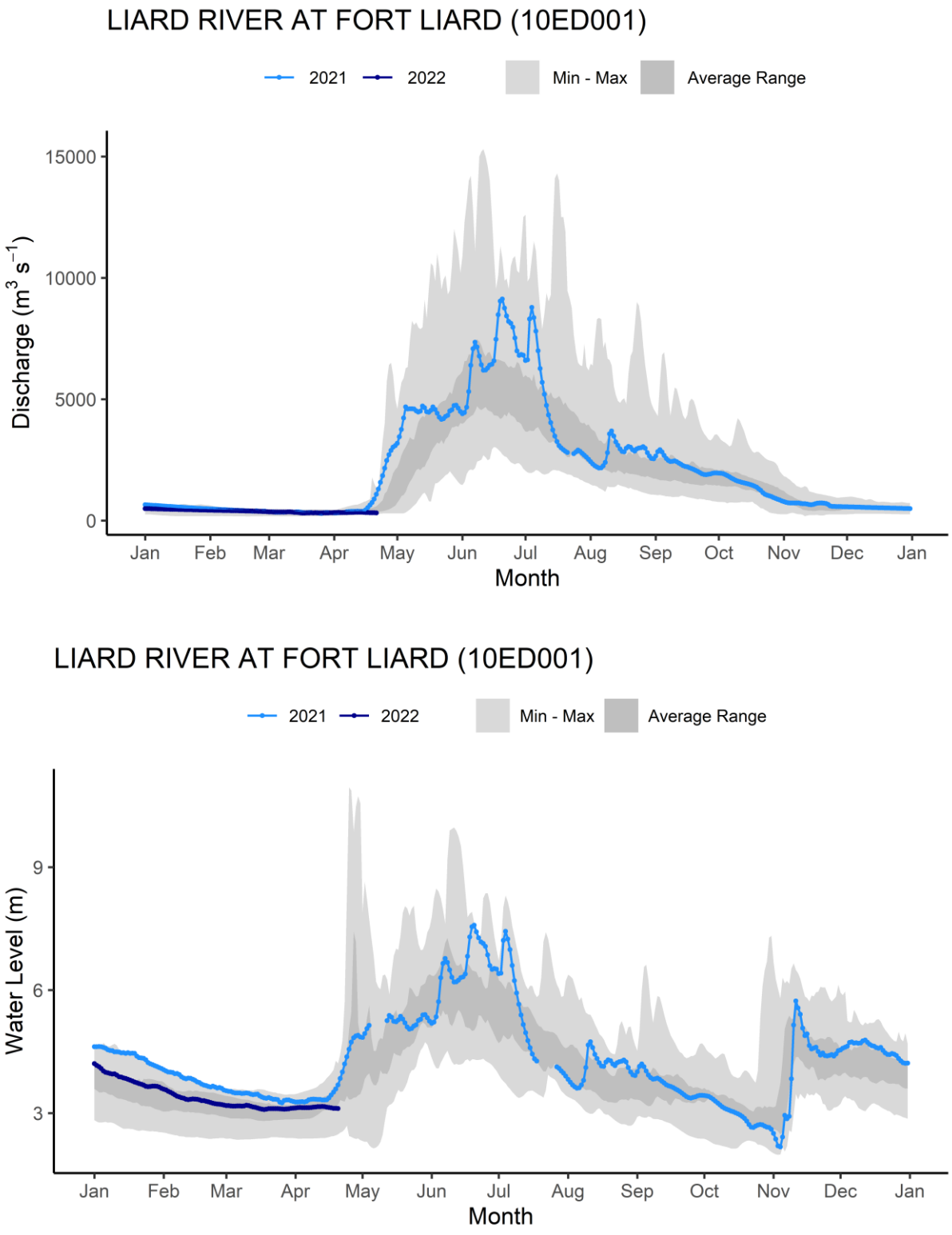


Figure 5: Water flows and levels on the Liard River at Fort Liard for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums

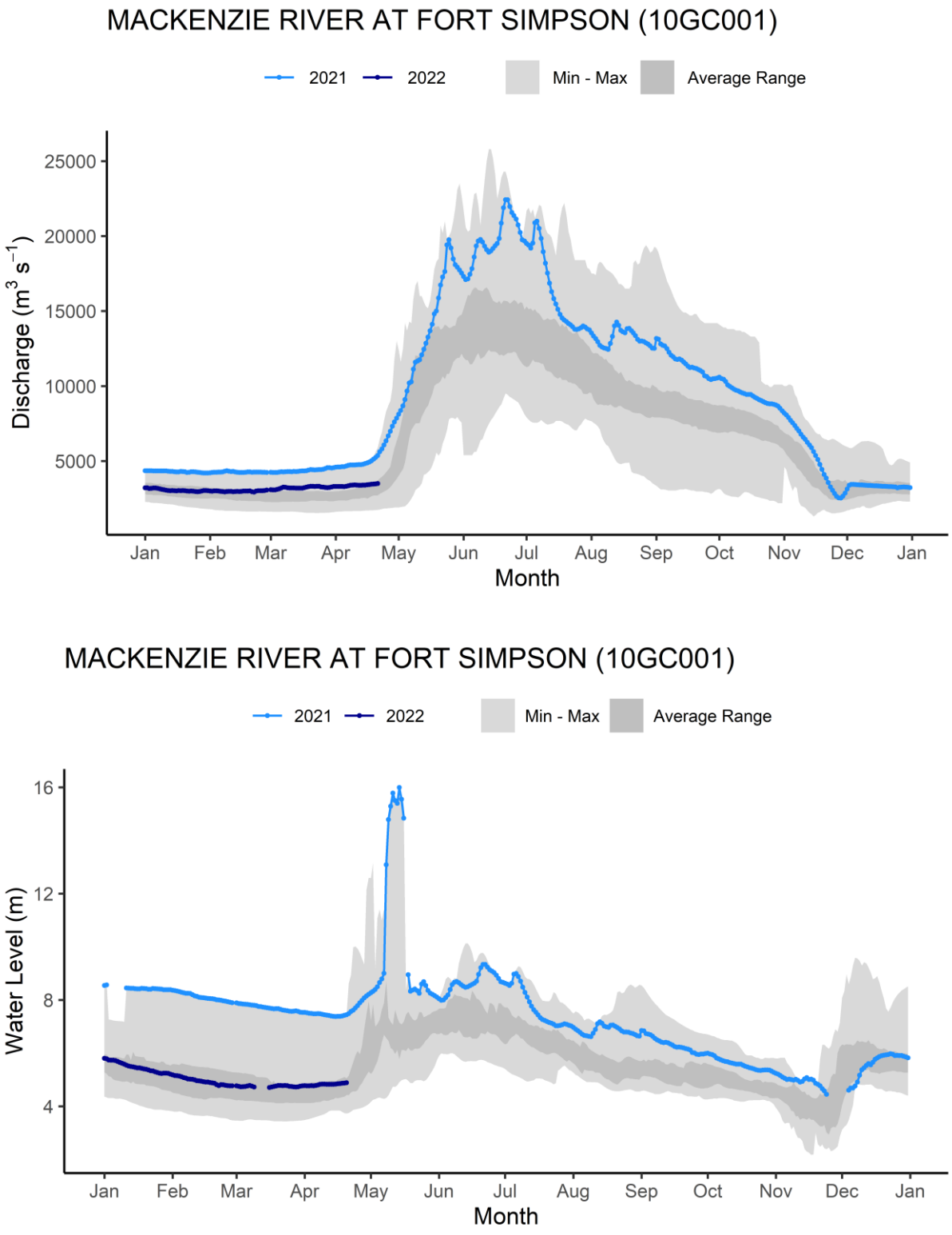
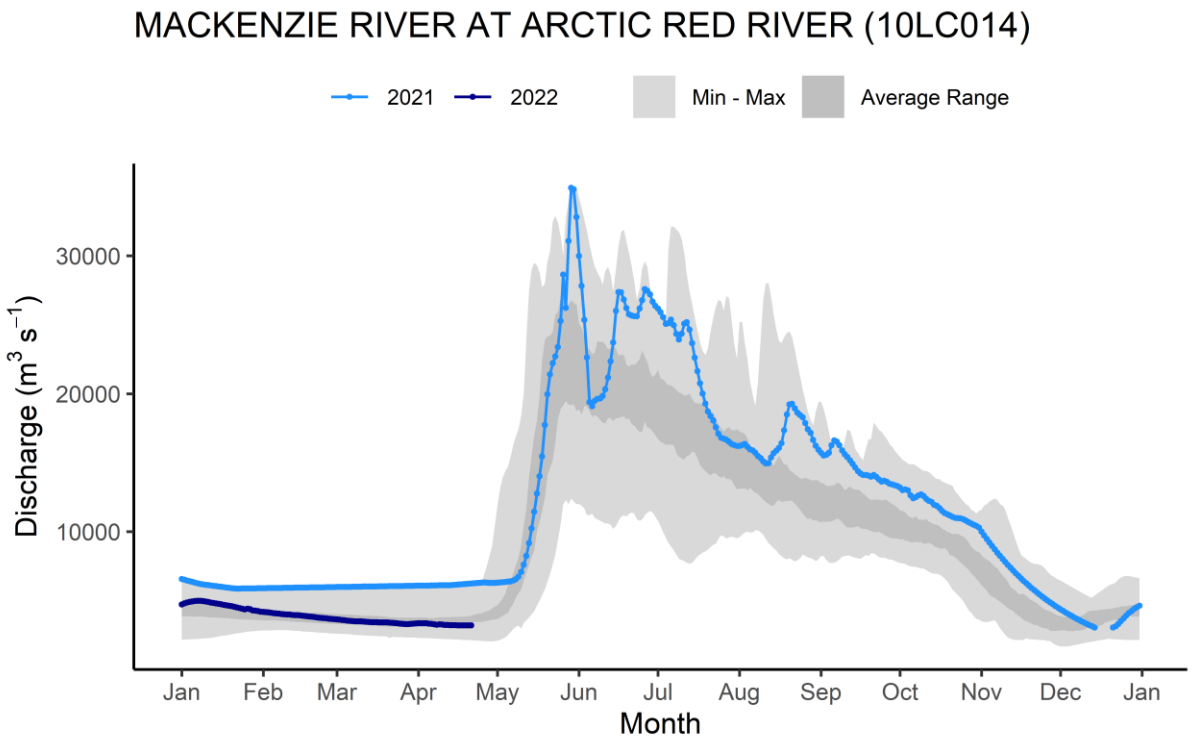


Figure 6: Water flows and levels on the Mackenzie River at Fort Simpson for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums



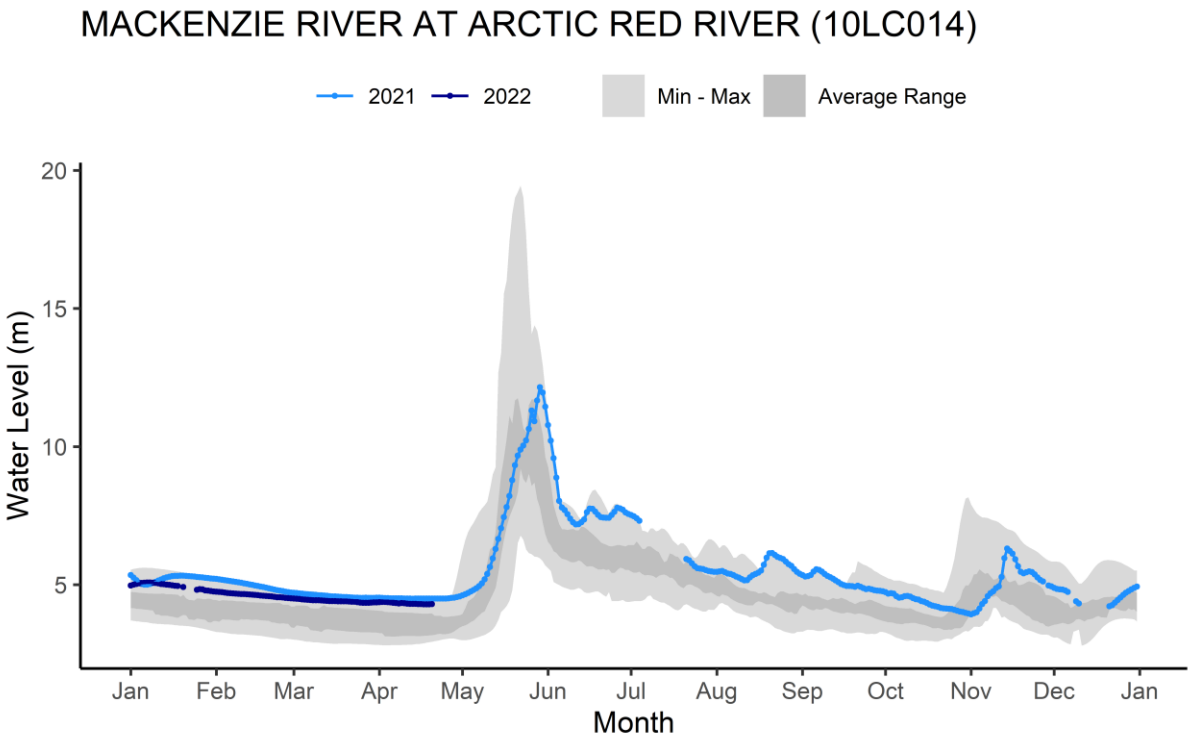
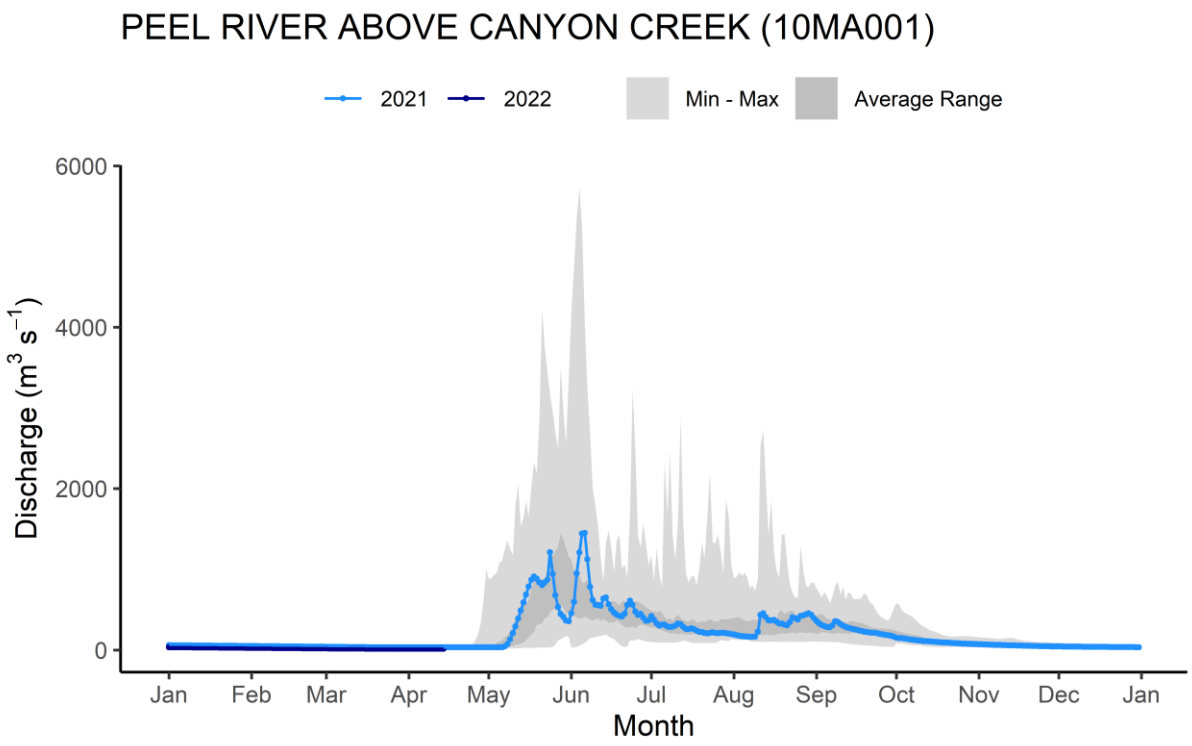


Figure 7: Water flows and levels on the Mackenzie River at Tsiigehtchic (Arctic Red River) for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums



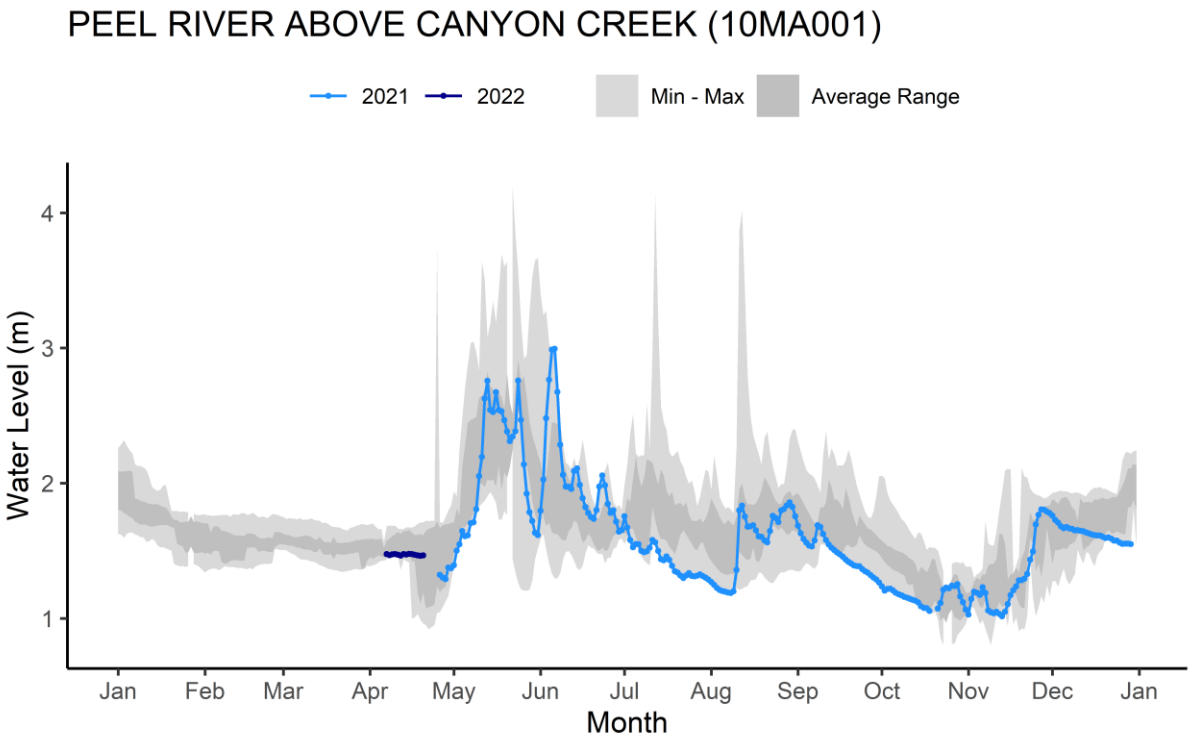


Figure 8: Water flows and levels on the Peel River at Canyon Creek (YT) for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums

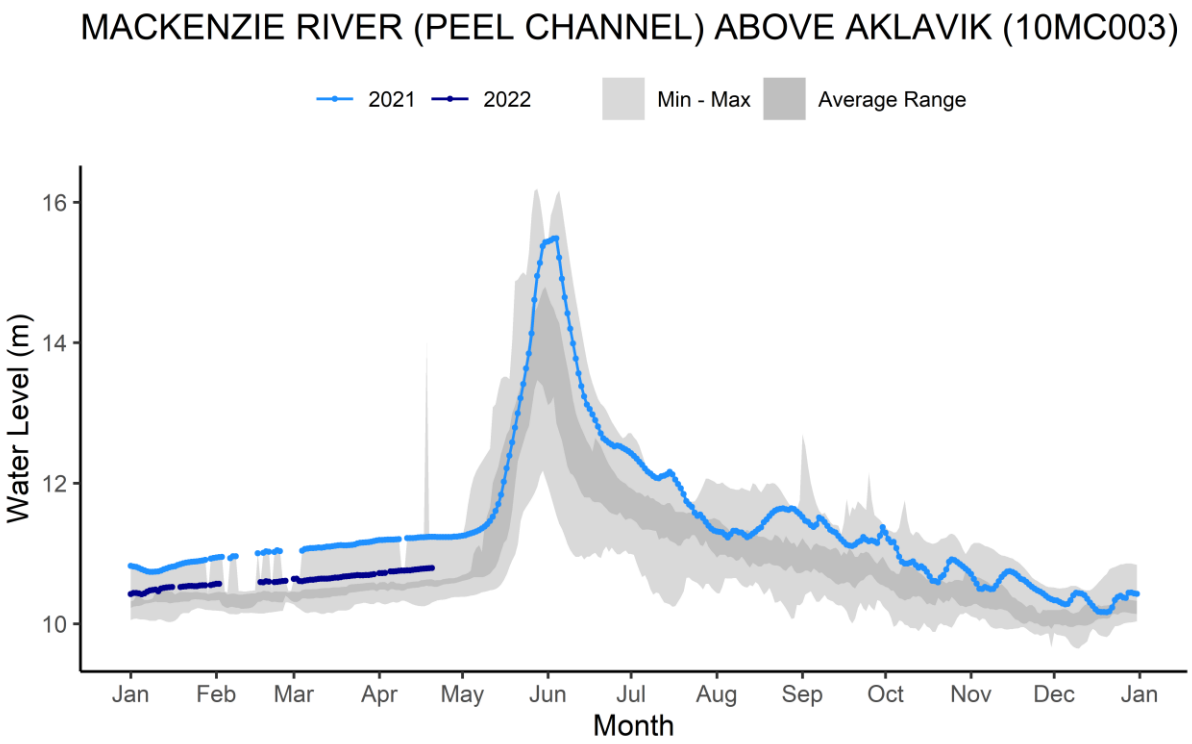


Figure 9: Water levels on the Mackenzie River above Aklavik for 2021 and 2022, relative to the historic average range (defined as the interquartile range) and historic maximum and minimums. Note that flow data are currently unavailable

Appendix D: Other resources

Data from other jurisdictions can be found at the following links:

Yukon Territory

https://yukon.ca/en/snow-surveys-and-water-supply-forecasts

Province of British Columbia

https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/drought-flooding-dikes-dams/river-forecast-centre/snow-survey-water-supply-bulletin

Province of Alberta

https://rivers.alberta.ca/#

Province of Saskatchewan

https://www.wsask.ca/lakes-rivers/provincial/