HISTORICAL CHANGES IN CHANNEL MORPHOLOGY MAXAN CREEK AND BULKLEY RIVER

Prepared for:

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EXECUTIVE SUMMARY

Northwest Research and Monitoring, on behalf of the Morice Watershed Monitoring Trust, are proposing to undertake stream restoration projects within the Maxan Creek and Bulkley River watersheds. Hydrotechnical support for this work is being provided by M. Miles and Associates Ltd., Consulting Geomorphologists.

The initial phase of this project includes the analysis of historical air photos to identify the location and magnitude of changes in channel morphology over time. The area of interest is the lower 10 km of Maxan Creek and the upper 10 km of Bulkley River in the vicinity of Bulkley Lake. This analysis provides a basis for locating sites of interest where ground studies might be undertaken, facilitating discussions with land owners and developing potential restoration strategies.

The report reviews the physical and hydrological setting, and discusses regional land use as relevant background for the historical analyses. Eight or nine images have been compiled at a common scale to document changes in channel conditions over the period since 1955. The most recent imagery is from 2016, 2019 or 2021.

Annual maximum discharge data from the comparatively regionally long term hydrometric station on Bulkley River at Houston indicates that there is a statistically significant probability that peak flows have increased over the 59 year period of record. Calculations by Foundry Spatial (2021) indicate that the equivalent clearcut area at the mouth of Maxan Creek was 67% in 2019. Air photo inspection of Foxy Creek (a tributary stream) and Maxan Creek indicates that the sediment supply has increased and that the channel has become more unstable in undisturbed valley flat areas. This implies that watershed scale effects could be influencing channel processes.

Morphologically significant channel changes have occurred on both Maxan Creek and Bulkley River as a result of valley flat land use practices. Agricultural clearing has locally reduced the riparian vegetation cover and increased channel instability. The extent of unvegetated instream sediment deposits has also been affected. The railway grade has cut off numerous former channels on Bulkley River. Local access roads and bridges have had similar effects. Beaver dams are evident in the upper areas on Maxan Creek but their distribution is more limited in cleared areas on lower Maxan Creek or the developed sections of Bulkley River.

Possible restoration activities have been identified for twelve areas. Restoration suggestions have been prepared from the perspective of how best to restore the physical processes responsible for creating and maintaining stream conditions. This includes the use of soil bioengineering techniques to stabilize sections of the channel bed or banks and to expedite the development of a woody riparian reserve within which the river is allowed to shift. Beavers are also thought to have historically played an important role in providing habitat and connecting flood plains to the river. It is therefore recommended that the effects of the railway grade and similar structures be inspected and mitigation opportunities identified. This might include installing beaver dam analogues or re-introducing beaver. Additional measures to provide habitat structure could also be employed as warranted.

ACKNOWLEDGMENTS

The authors would like to thank the following people for advice or assistance with the work described in this report:

Jeff Anderson	Geomorphic Consultants	Smithers, BC
Laura Guillon	Northwest Research & Monitoring	Smithers, BC
Ian Niblett	FLNRORD	Vanderhoof, BC
Chelton Van Geloven	FLNRORD	Prince George, BC
Ben Kerr	Foundry Spatial	Victoria, BC

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

STATEMENT OF LIMITATIONS OF REPORT

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This document represents MMA's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by scientists and engineers currently practising under similar conditions. No warranty, expressed or implied, is made.

HISTORICAL CHANGES IN CHANNEL MORPHOLOGY MAXAN CREEK AND BULKLEY RIVER

1: INTRODUCTION AND OBJECTIVES

Northwest Research and Monitoring [NWRM], on behalf of the Morice Watershed Monitoring Trust [MWMT], are proposing to undertake stream restoration projects within the Maxan Creek and Bulkley River watersheds. Hydrotechnical support for this work is being provided by M. Miles and Associates Ltd. [MMA], Consulting Geomorphologists. The BC Ministry of Forest, Lands, Natural Resource Operations and Rural Development [FLNRORD] in Prince George is also assisting by providing drone imagery of present river conditions, land use information and other support.

The initial phase of this project includes the analysis of historical air photos to identify the location and magnitude of changes in channel morphology over time. This analysis provides a basis for locating sites of interest where ground studies might be undertaken, facilitating discussions with land owners and developing potential restoration strategies.

Discussions with NWRM, and an initial review of aerial imagery, were undertaken to determine where historical analyses would be most beneficial. This analysis indicated that the lower 10 km of Maxan Creek upstream of Bulkley Lake and the 10 km of Bulkley River located downstream of Bulkley Lake have a high potential for future restoration work (Figure 1.1). Within this area, substantial changes in channel morphology and stability have occurred since the earliest readily available air photos were flown in 1955. We were therefore requested to compile and interpret a series of historical air photos for these sections of channel.

2: REPORT OUTLINE AND METHODOLOGY

A brief discussion of the physical and hydrological setting is presented prior to discussing the results of the study. Restoration suggestions have been prepared from the perspective of how best to restore the physical processes responsible for creating and maintaining stream conditions. This includes the use of soil bioengineering techniques to stabilize sections of the channel bed or banks and to expedite the development of a woody riparian reserve within which the river is allowed to shift. Beavers are also thought to have historically played an important role in providing habitat and connecting flood plains to the river. Additional measures to provide habitat structure, such as described in Slaney and Zaldokas (1997), could also be employed as warranted.

Information compiled for Maxan Creek and Bulkley River are contained in Appendices 1 and 2, respectively. The most recent Google Earth imagery has been compiled at a scale of 1:7,500 for both streams. To facilitate site identification, channel distances measured along the thalweg, have been indicated based on river conditions as shown on BC Government 1:20,000 mapping, copyrighted in 2016. Subsequent shifts in channel locations have affected channel lengths in some locations.

Air photos have been obtained from the UBC Air Photo Library. Imagery from 1955, 1959, 1971, 1975, 1986, 1998, 2005, 2016 or 2019 has been compiled at a common scale of 1:10,000. The most recent available Google Earth imagery is from 2016 or 2019. FLNRORD therefore kindly flew drone imagery for the lower 4 km of Maxan Creek and the upper 2 km of Bulkley River in May of 2021 to provide more current information.

The compiled imagery has been annotated to indicate changes in land use and channel conditions. The year and, where known, the date of the employed imagery has been indicated on the compiled air photos. This provides an indication of seasonal change in vegetation cover and streamflow. Maps showing the location of the image compilations are included in the Appendices.

3: PHYSICAL SETTING

Maxan Creek at the confluence with Bulkley Lake has a watershed area of 371 km^2 (NW Water Tool, 2021). Elevations range from 718 m to 1552 m. Streamflow and coarse sediment input is naturally attenuated by storage in Maxan Lake. Foxy Creek (96.5 km^2) is the largest tributary downstream of Maxan Lake and joins the mainstem channel near the lake outlet. The total straight line distance from Maxan Lake to Bulkley Lake is approximately 12 km.

Bulkley River has a watershed area of 502 km^2 at the downstream end of the study area (NW Water Tool, 2021). This includes an area of 131 km^2 which reflects local inflows other than Maxan Creek. Elevations range from approximately 700 m to 1552 m. Streamflow and coarse sediment input in Bulkley River is naturally attenuated by both Maxan and Bulkley Lakes.

4: HYDROLOGICAL SETTING

Representative discharge data are available from the Water Survey of Canada [WSC] hydrometric stations:

- Maxan Creek above Bulkley River (basin area 364 km^2);
- Buck Creek at the Mouth (basin area 567 km^2); and
- Bulkley River near Houston (basin area 2310 km^2)

Station locations are indicated on Figure 1.1.

The seasonal variation in flow observed at these sites is illustrated on Figures 4.1 to 4.3. This analysis indicates that the spring snow melt freshet is the dominant hydrological event. Streamflows typically begin to increase in April, peak in May or June and decrease in July. Fall rains, or rain on snow events, can also result in a second period of elevated flows between September and November. Data compiled using the NW Water Tool (https://nwwt.bcwatertool.ca/) has been used to estimate flows at the outlet of Maxan Creek and on Bulkley River at the downstream end of the study area. These analyses, which are shown on Figures 4.4 and 4.5 confirm the seasonal distribution of runoff described above and provide an indication of the potential magnitude of the average monthly discharge.

The historical variation in peak flows observed at the WSC gauging stations is illustrated on Figures 4.6 to 4.8. These data indicate that maximum flows observed at the Maxan Creek Above Bulkley Lake gauging station approached approximately 40 m^3/s in the period between 1974 and 1979. On the basis of regional data, sizeable flood events likely occurred in 1997, 2002, 2011 and 2018. These regional data suggest that there might be a trend towards larger flood flows. Statistical analyses (Q, R and W statistics described in Buishand, 1982) indicate that the annual maximum peak flows observed at Bulkley River near Houston have experienced a statistically significant shift in regime. The flood

flows are larger than those which occurred prior to 1994. Inspection of the historical air photos also suggest that a sizeable flood likely occurred between 1971 and 1975.

Additional hydrometric information is available from the Northwest Water Tool website and from reports by Ahmed and Jackson (2013), Geomorphic Consulting (2018), and Swiftwater Consulting (2019 and 2021).

5: LAND USE

The location of range and forest tenures within the study area is indicated on Figures 5.1 and 5.2, respectively based on information provided by FLNRORD (Chelton Van Geloven, pers. comm.). This mapping indicates that cattle have access to Maxan Creek between the outlet of Maxan Lake and approximately 5 km upstream of the confluence with Maxan Creek and Bulkley Lake. Widespread logging activity has occurred within the upstream watershed.

Figure 5.3 illustrates the post 1985 changes in equivalent clearcut area (ECA) on Maxan Creek at the confluence with Bulkley Lake, based on preliminary analyses provided by Foundry Spatial (Ben Kerr, pers. comm.). These data are potentially confounded as they reflect harvest, pest and fire history. However, there is a significant increase in ECA values between 2004 (9.3%) and 2008 (38.0%). The ECA in 2019 (the most recent available number) was 67.3 %. This indicates that forest cover has been severely impacted since the mid 2000's and changes in stream channel conditions should be expected.

6: TEMPORAL CHANGES IN CHANNEL MORPHOLOGY AND POSSIBLE RESTORATION PRIORITIES

6.1 MAXAN CREEK

6.1.1 Upstream of River KM 10

Foxy Creek (basin area 96.5 km^2) is a left bank tributary which joins Maxan Creek near the outlet of Maxan Lake. GoldCorp Canada Limited's Equity Division operates a mine at Lu Lake in the headwaters. Inspection of Google Earth imagery indicates that this watershed is producing substantial amounts of coarse sediment and that these materials have formed a fan at the confluence with Maxan Creek. These sediments are also being carried downstream and could be at least partially responsible for the observed channel destabilization in the area of Maxan Creek upstream of River Km 10. It is also possible that the high ECA values are increasing flood flows. Additional historical and other analyses are required to determine the cause of channel instability in this area.

6.1.2 River KM 10.0 to 7.3

The section of Maxan Creek between River Kms 10 and 7.3 consists of an irregularly meandering, generally single thread channel[*1]. The stream is flowing within a wide valley flat. Riparian land use includes logging activity but the 2016 imagery indicates that there is a largely intact riparian reserve over 100 m in width. Exception occurs at Km 9.7 where a pre-1955 clearing extended to the left channel bank and at Km 9.2 where a pre-1986 clearing occurred on the right bank. A number of sizeable beaver dams and upstream ponds occur on the left bank valley flat. These appear to be well maintained and active in 2016.

The compilation of historical imagery clearly indicates a trend of increasing channel instability. This has resulted in wider unvegetated channel widths and enlarged instream sediment accumulations. These changes in channel stability do not appear to be a result of riparian clearing.

Possible remedial work would include reducing upstream sediment production and expediting reforestation in the upstream watershed. Land use practices which preserve the valley flat vegetation should also be encouraged. Within this section of channel, live gravel bar staking (Polster, 2001; Polster et al., 2010) could be undertaken to stabilize the numerous unvegetated and mobile instream sediment accumulations. However, this would be difficult as there is no riparian access. Additional ground inspection might indicate that cattle grazing was affecting the channel and fencing or other techniques (described in Adams and Fitch, 1995) might be appropriate. The presence of active beaver dams and ponds is encouraging and measures should be undertaken to protect or expand these features where possible.

6.1.3 River KM 7.3 to 5.0

The section of Maxan Creek between River Kms 7.3 and 5.0 is similar to the upstream channel except that the amount of valley flat and riparian clearing is more extensive. The channel has also become increasingly unstable over time and meander progression and cutoffs have occurred. The extent of instream sediment accumulations, as well as the unvegetated channel width, have also increased. My impression is that bank erosion along areas with a reduced riparian tree cover has likely played a contributing role. Beaver dams occur on the left bank valley flat.

Locally re-establishing a robust treed bank vegetation appear warranted. Similarly, using live gravel bar staking to stabilize the sizeable instream sediment accumulations would be beneficial. Equipment access to these areas would not be as challenging as in the upstream area. If confirmed by drone or other current imagery, the potential benefits of encouraging the formation of beaver dam or beaver dam like structures could be evaluated. If warranted, procedures described in Wheaton et al., 2019 could be used to construct analogue structures or promote beaver re-colonization.

6.1.4 River KM 5.0 to 2.0

Extensive areas of valley flat on Maxan Creek between River Km 5.0 (at the right of way crossing) and River Km 2.0 has been cleared for agricultural purposes. For example, an approximately 2 km portion of the left bank is devoid of riparian vegetation. This has been associated with extensive channel

1 The employed terminology follows Kellerhals, Church and Bray, 1976

instability, ongoing bank erosion and meander bend cutoffs or channel avulsions. An approximately 1 km long unvegetated instream sediment accumulation occurs at the upstream end of this section of channel. Cleared fields show river channel traces and historical imagery indicates that these areas were formerly better connected to the river and flood plain.

Substantial changes in channel morphology occurred between 2016 (the most recent available imagery for the upstream channel) and the 2021 drone imagery. This includes the formation of a sizeable area of inundated flood plain located within the former boundaries of the main channel. This development implies that morphologically significant changes could also have occurred since the now dated upstream imagery was acquired.

The initial restoration objective should be to re-establish woody riparian bank vegetation using a combination of soil bioengineering techniques and or planting. This is being done successfully on Chilako River near Prince George and interested land owners or others should be encouraged to visit this project. Equipment can readily access this area.

The recently established mid-channel inundated area should be inspected to determine if this is a result of beavers, a log jam, seasonal high water levels or other factors. There may be opportunities to preserve or enhance this wetted area. Similarly, it might be possible to develop the wetted areas within the adjacent fields (visible on the May 2021 imagery) to enhance habitat values. The ecological benefit of this work would need to be discussed with the property owner and an agreement reached on what work they would be willing to permit.

6.1.5 River KM 2.0 to Bulkley Lake

The left bank along the lower 2 km of Maxan Creek has been cleared for grazing or hay production. The right bank is more pristine and is comparatively well vegetated. The earliest historical imagery indicates that the channel contained sizeable instream sediment accumulations in 1955 and became increasingly unstable until approximately 2005. The 2016 and 2021 imagery suggest that recent channel instability has been locally reduced. This possibly reflects the establishment of narrow discontinuous segments of riparian vegetation.

The initial restoration objective should be to establish continuous woody riparian bank vegetation along the left channel bank. This is likely best undertaken using a combination of soil bioengineering techniques and or planting. Irrigation may be required to assist in initial plant growth. Fencing might also be required to limit cattle access during the summer growing season. Live gravel bar staking might be employed to expedite the revegetation of exposed instream sediment accumulations.

Other possible restoration opportunities include enhancing the area of wetted depressions on the left bank that are visible on the 2021 imagery. This might include connecting the former wetland areas to the inundated section of flood plain that occurs in the upstream channel. It might be possible to reach an agreement with the landowner to allow this area to be used to provide ecological benefit and reconnect the flood plain to the river.

6.2 BULKLEY RIVER

6.2.1 River KM 0 to 1.0

The section of Bulkley River between River Kms 0 and 1.0 consists of a laterally stable, irregular, single thread, channel. A railway and a local access bridge are located in this area. Numerous relic channel traces are visible on the cleared left bank field.

The historical air photos indicate that there was a progressive loss of riparian vegetation until some time between 1986 and 1998. After this time, a narrow band of discontinuous riparian vegetation has become established.

The initial restoration objective should be to expand the width and continuity of the riparian vegetation.

6.2.2 River KM 1.0 to 1.9

This approximately 0.9 km long section of Bulkley River consists of an irregularly meandering single thread channel. Meander progression has resulted in the formation of wide unvegetated point bars. Crow Creek, a tributary stream, enters from the left bank. Much of the left bank valley flat has woody vegetation cover. However, portions of the right bank have been cleared.

Restoration objectives in the area include establishing riparian vegetation along both banks. A site inspection should be undertaken to evaluate the potential benefits of stabilizing the unvegetated point bars and increasing the resistance of the eroding sections or river bank using soil bioengineering techniques. It might also be beneficial to inspect Crow Creek and determine if there are additional measures that could be undertaken to improve habitat conditions.

6.2.3 River KM 1.9 to 4.0

The section of Bulkley River between River Kms 1.9 and 4.0 consists of an irregularly meandering channel containing vegetated islands, former river channels and oxbows. Meander progression has formed sizeable unvegetated point bars and sections of channel have relocated through the cleared fields which occur on both the left and right bank valley flats.

The historical analyses indicate that construction of the railway grade cut off or encroached into numerous former channels. This may have isolated a left bank wall based channel opposite approximately River Km 2.5. The maximum extent of instream sediment accumulations occurred around 1998. However, a sizeable abrupt shift in channel location (or avulsion) occurred through a left bank field at approximately River Km 3 between 2005 and 2019. Subsequent erosion has resulted in sediment production and the formation of unvegetated sediment deposits in the downstream channel.

It is suggested that the railway grade be inspected to identify areas where it could be possible to improve water flow in the vicinity of former channels. Relic channels should also be inspected to assess the potential for improving access or connectivity to the flood plain. This might include measures to introduce beavers or to provide beaver dam analogues. The left bank channel relocation should also be inspected to determine if this was assisted by anthropogenic activity. Re-establishing stream bank vegetation, increasing the erosion resistance of eroding banks and stabilizing instream

sediment accumulations using soil bioengineering techniques would benefit channel stability and habitat values.

6.2.4 River KM 4.0 to 4.8

Bulkley River has formed a single thread channel which is located near the right bank valley wall. A wide cleared field forms the left bank valley flat. The railway grade bisects the field and crosses a number of former river channels. There is a bridge across the river that provides access to the left bank field. The historical analysis documents the progressive clearing of the left bank field, the drainage of former river channel traces, the loss of riparian vegetation and local bank erosion. The maximum extent of instream sediment accumulations again occurred around 1998. Efforts to re-establish riparian vegetation have been subsequently undertaken and have been locally successful.

It is suggested that the railway grade be inspected to determine if there is an opportunity to improve conditions around the cut off channel located near the downstream end of the left bank field. Soil bioengineering techniques could be beneficially employed in the upstream segment of this area and in the vicinity of bridge. This could include promoting stream bank vegetation, increasing the erosion resistance of eroding banks and stabilizing instream sediment accumulations.

6.2.5 River KM 4.8 to 8.0

This comparatively undeveloped section of valley flat extends downstream to Crow Creek Road. Bulkley river has formed an irregularly to tortuously meandering channel within the wide flood plain. The railway grade crosses the river, bisects the flood plain, has cut off former segments of river channel and isolated a segment of the right bank valley flat. There is also a farm on the right bank near the upstream end of this area.

The historical analysis indicates that ongoing channel instability is occurring in the vicinity of the farm. The maximum extent of instream sediment accumulations occurred between 1998 and possibly 2005.

It is suggested that the railway grade be inspected to identify areas where it could be possible to improve water flow though former channels. Relic channels should also be inspected to assess the potential for improving access or connectivity to the flood plain. This might include measures to introduce beavers or to provide beaver dam analogues. The area around the right bank farm should be inspected to evaluate the feasibility and potential benefit of stabilizing the unvegetated instream sediment accumulations using soil bioengineering techniques.

6.2.6 River KM 8.0 to 10.0

This approximately 2 km long section of channel extends downstream of the Crow Creek Road crossing. Within this area, Bulkley River has formed an irregularly meandering, generally single thread, channel. Meander progression and cutoff have occurred in the past and relic channel traces can be seen on the cleared fields which occur on portions of the left and right bank valley flat. The railway is located at the base of the right bank valley wall. The bridge on Crow Creek Road crosses the stream channel and the approach fills may locally restrict overbank flows on the valley flat.

The historical analysis indicates that a sizeable downstream meander bend could have been cut off following construction of the Crow Creek Road bridge sometime between 1986 and 1998. Subsequent

channel instability has resulted in bank erosion and instream sediment accumulations. Similarly, an approximately 1 km long meander bend cutoff occurred in the downstream channel between 2005 and 2019. This channel locally impinged on both the railway grade and the upstream field. However, there are no obvious indications that the cut off in the narrow point in the upstream channel was influenced by anthropogenic activity. The maximum extent of instream sediment accumulations again occurred around 1998. However, bank instability following the recent channel cutoffs have locally resulted in enlarged instream sediment accumulations. Further channel adjustments should be expected.

The bridge site should be inspected in the field. The requirements for stabilizing the stream channel or banks using soil bioengineering techniques should be evaluated. A similar assessment should be undertaken at the downstream cutoff channel. Former stream channels on both sides of the river should also be evaluated and the ability to improve water connectivity or habitat should be assessed.

6.2.7 River KM 10.0 to 12.0

Bulkley river has formed an irregularly to tortuously meandering channel within this wide flood plain. Meander progression and cutoffs are a common occurrence within this undeveloped area. There are numerous relic channels which now serve as wetlands and would historically have contained beavers.

The historical analysis indicates that the extent of instream sediment accumulations have varied over time with the maximum values occurring between approximately 1998 and 2005.

Given the lack of development, there are no obvious restoration objectives from a land use perspective. However, it might be useful to confirm that there are no riparian grazing impacts. This area might serve as a control against which the upstream channel conditions can be compared. It also might be a suitable site for determining if beavers are present, and if they are absent, re-introducing them. Similarly, this section of channel might be used as a reference reach against which habitat values and species abundance could be compared.

7: DISCUSSION

The analysis presented in this report are potentially dated as the most recently available imagery is from 2016 or 2019 for areas other than sections of stream close to Bulkley Lake. Current imagery, similar to that provided by FLNRORD, is required to document more recent changes in land use or channel conditions. If this information becomes available, it would be a simple task to update the restoration objectives.

Budget permitting, it would also be desirable to compile and analyze the historical air photos for Maxan Creek between River Km 10 and the outlet of Maxan Lake, plus at least the lower reaches of Foxy Creek, to better assess the source of the sediment that is depositing in the downstream channel.

Ground inspections will be required to verify the air photo interpretation and to confirm the initial restoration suggestions.

8: CERTIFICATION

This report has been prepared by:

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9: SOURCES OF INFORMATION

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9.2 PERSONAL COMMUNICATIONS

Chelton Van Geloven	Forest, Lands, Natural Resource Operations and Rural Development, Prince George
Ben Kerr	Foundry Spatial, Victoria

FIGURES

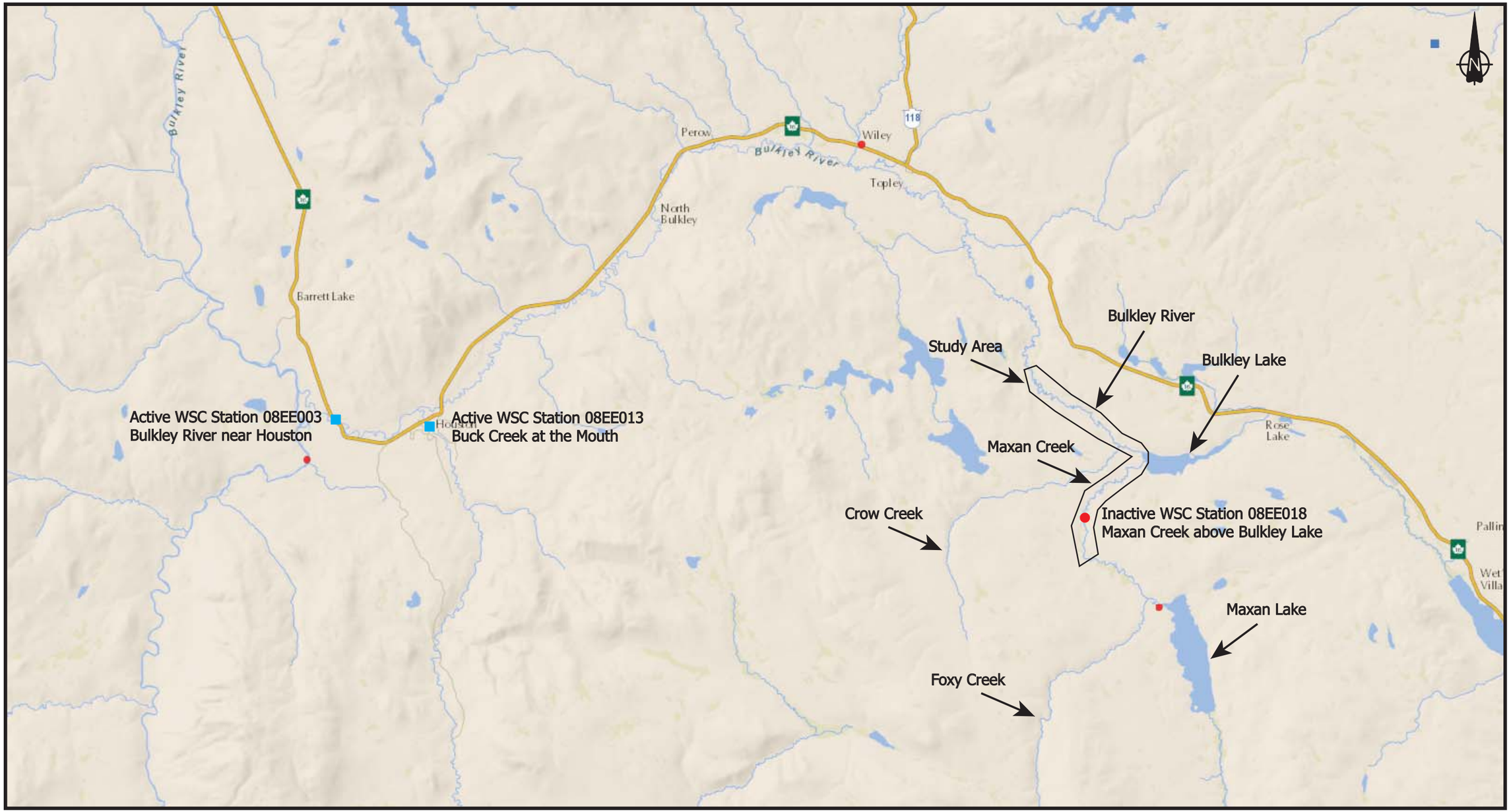


Figure 1.1: Location map.

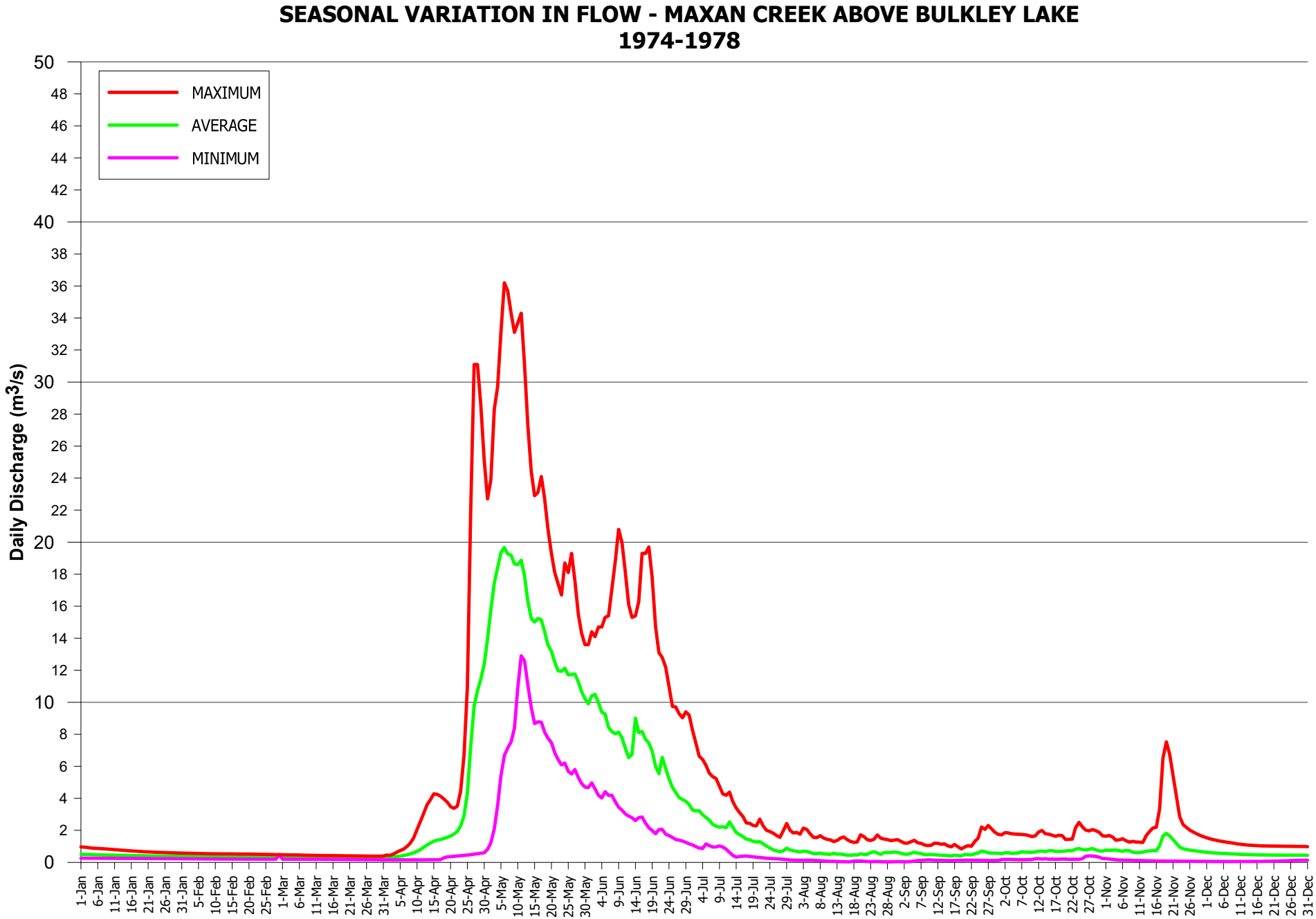


Figure 4.1: Seasonal variation in flow observed on Maxan Creek Above Bulkley Lake (1974-1978).

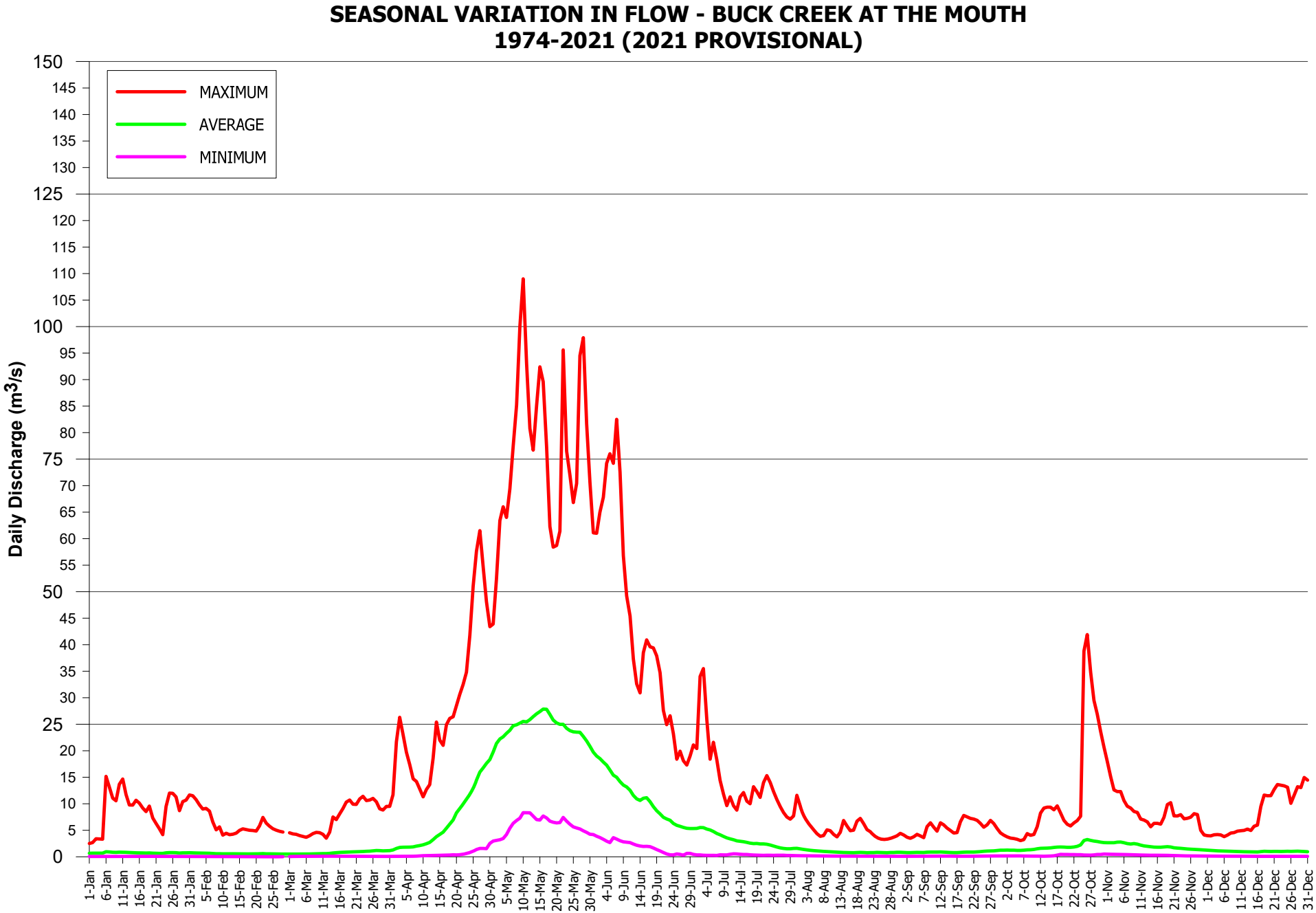


Figure 4.2: Seasonal variation in flow observed on Buck Creek at the Mouth (1974-2020 plus 2021 provisional).

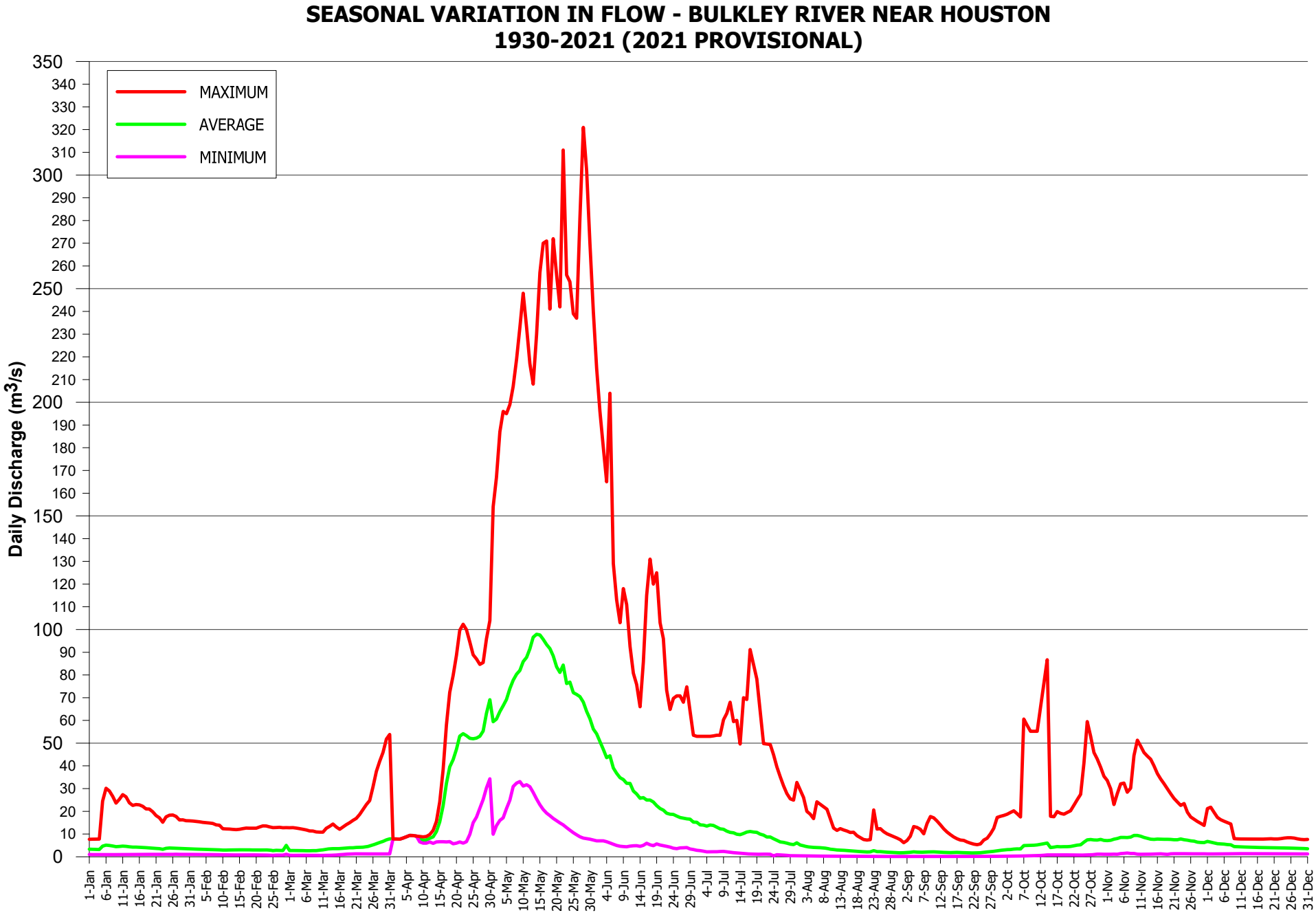


Figure 4.3: Seasonal variation in flow observed on Bulkley River near Houston (1930-2020 plus 2021 provisional).

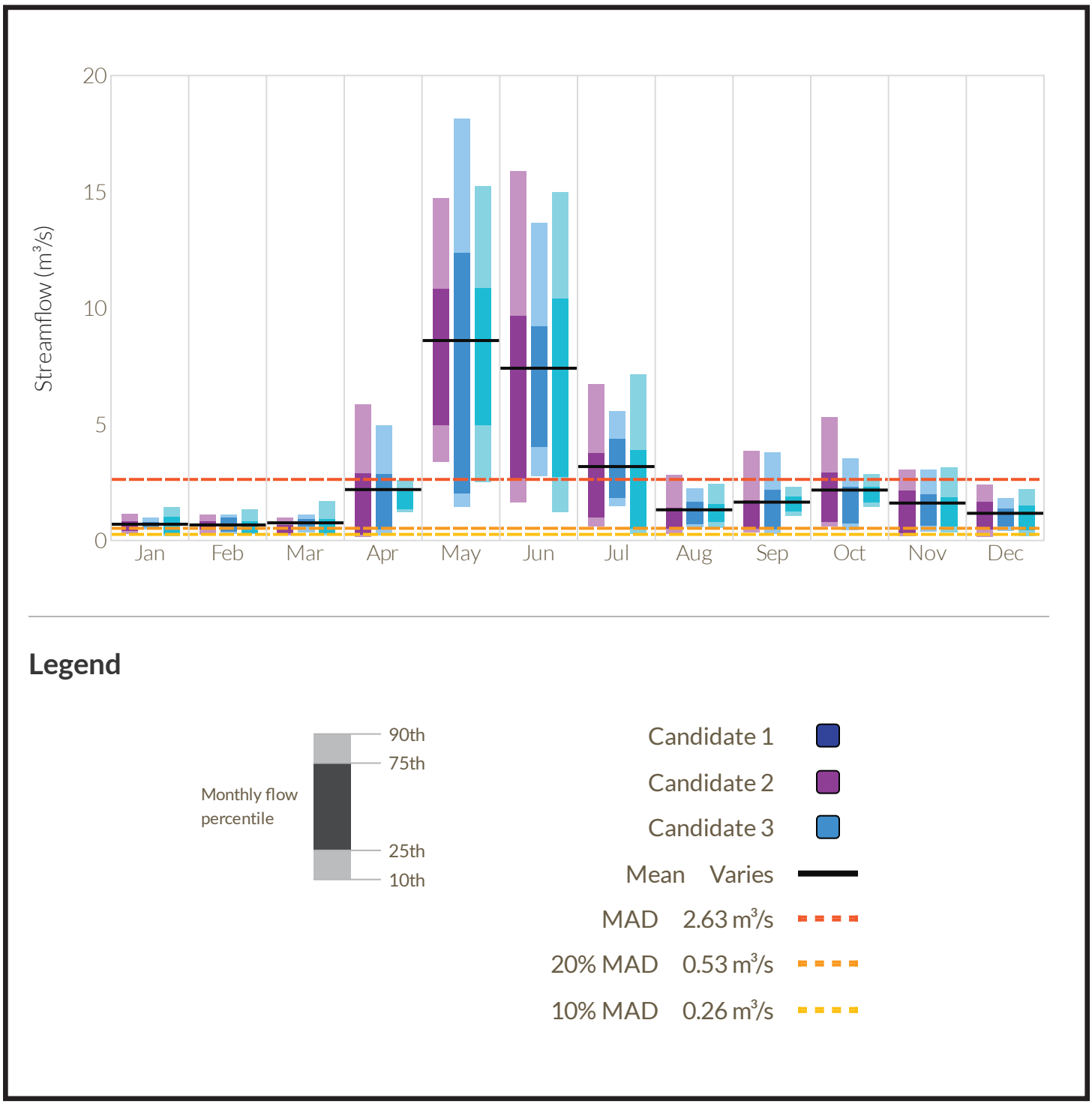


Figure 4.4: Estimated mean monthly flows at the outlet of Maxan Creek (from NW Water Tool).

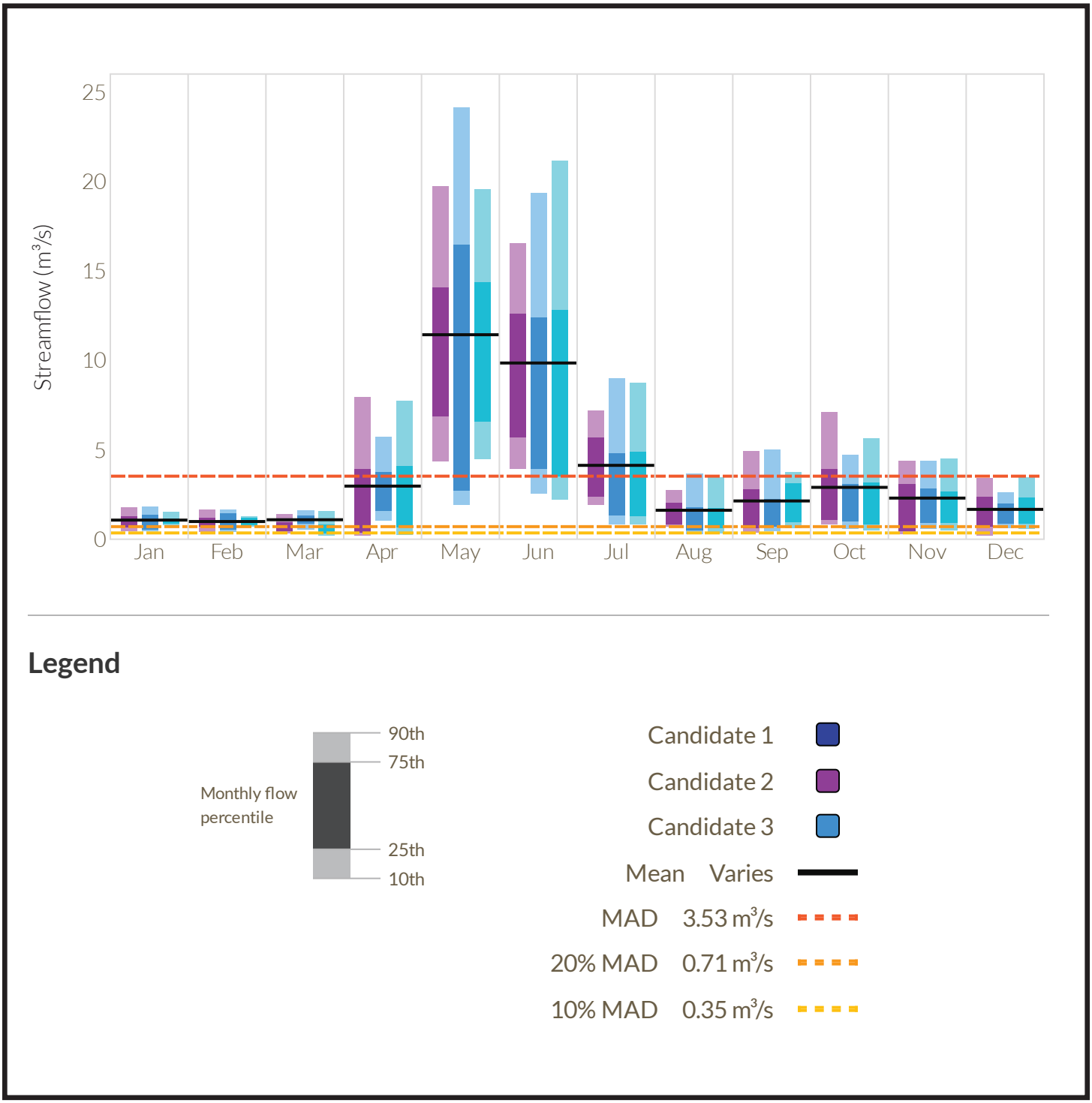
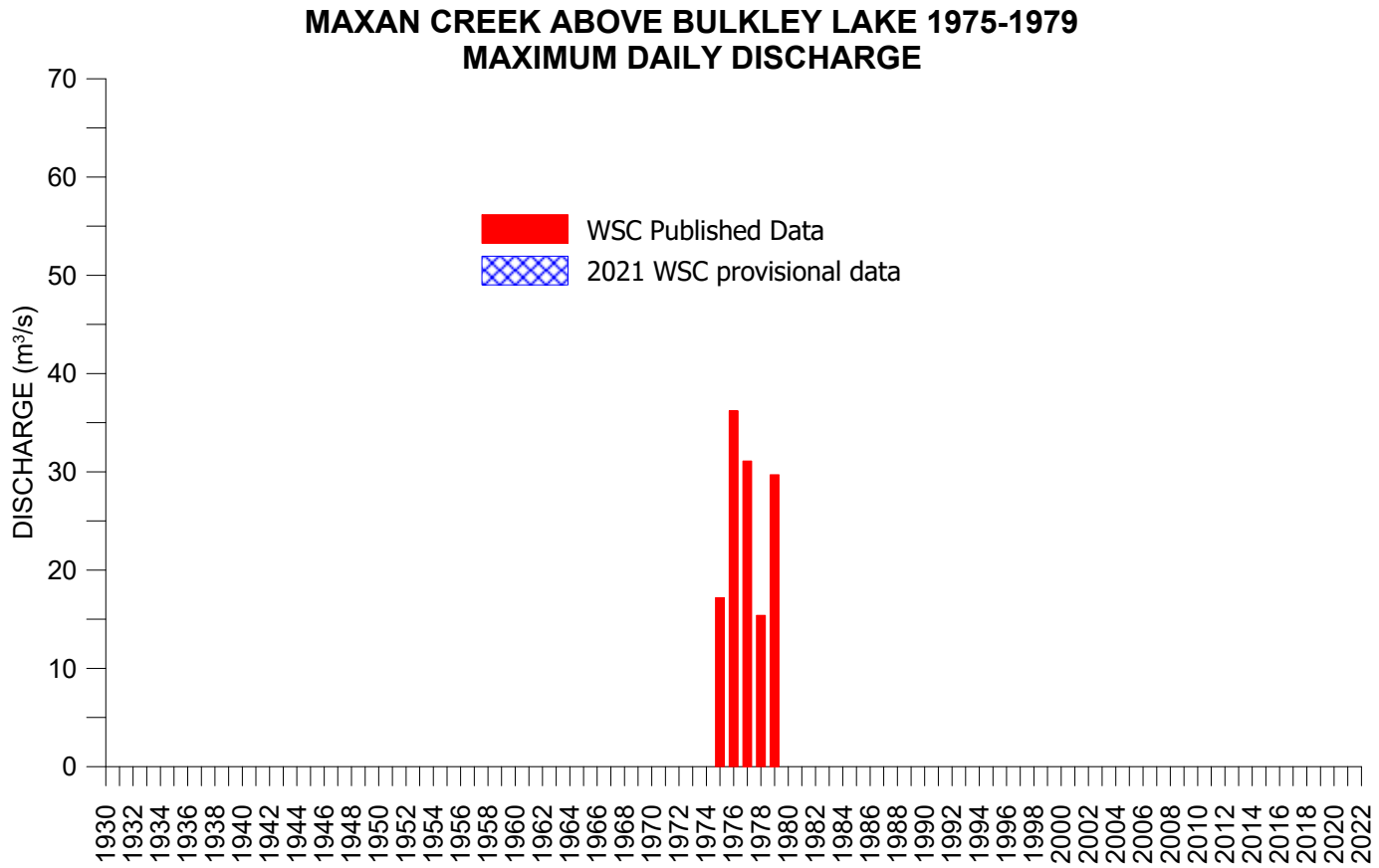


Figure 4.5: Estimated mean monthly flows on Bulkley River at the downstream end of our study area (from NW Water Tool).



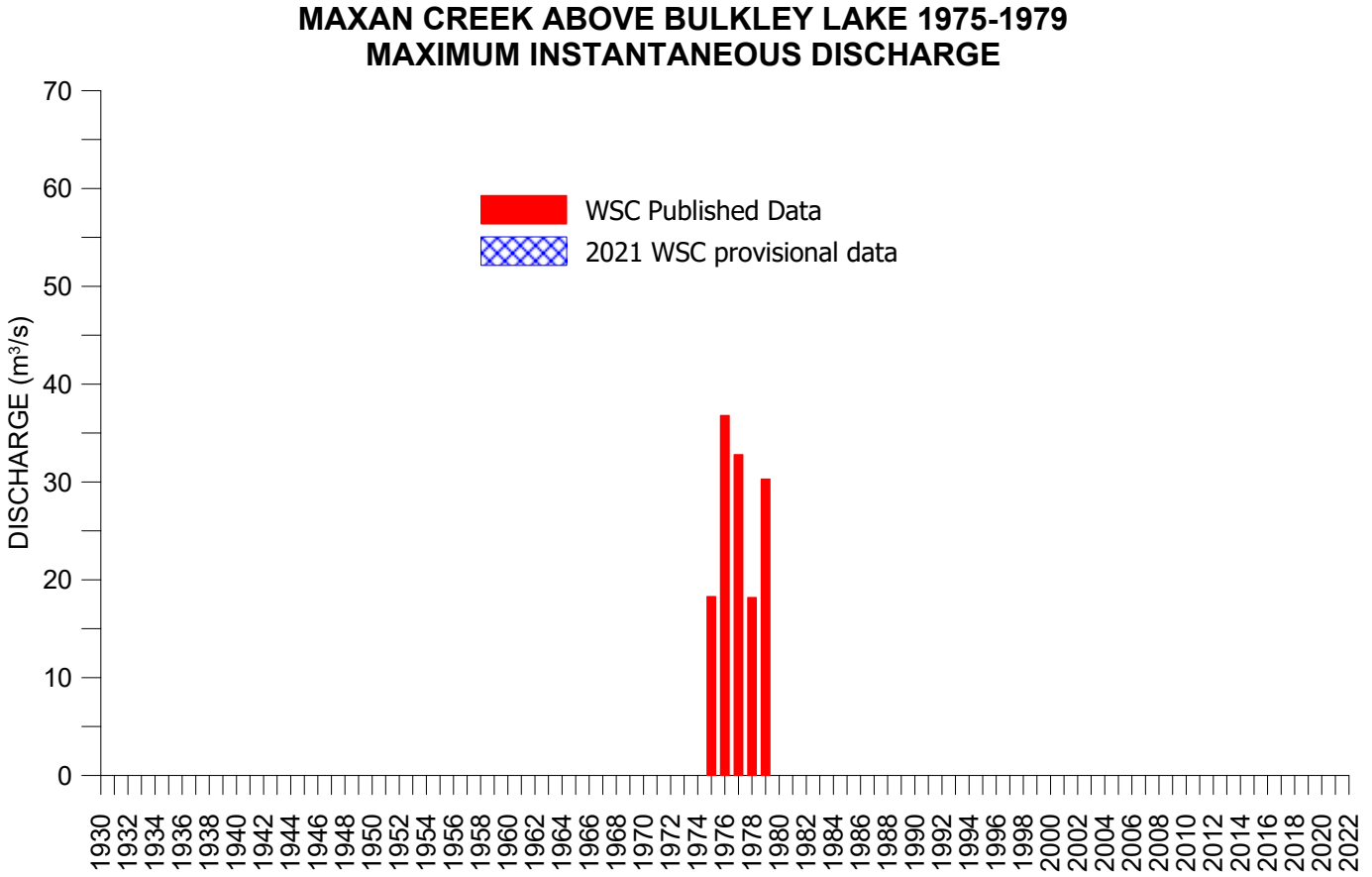
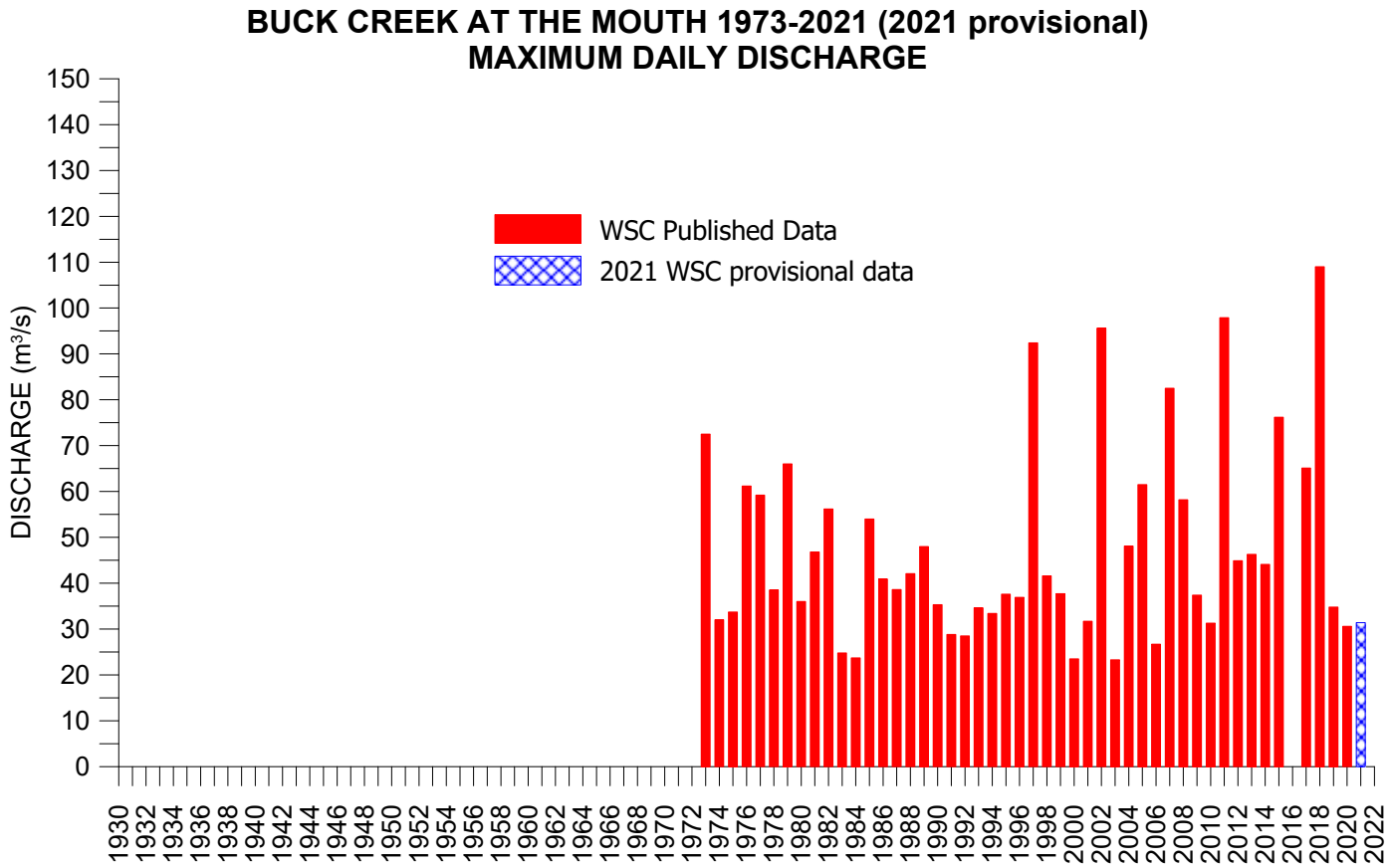


Figure 4.6: Historical variation in annual maximum daily and instantaneous discharge, Maxan Creek Above Bulkley Lake, 1975 to 1979.



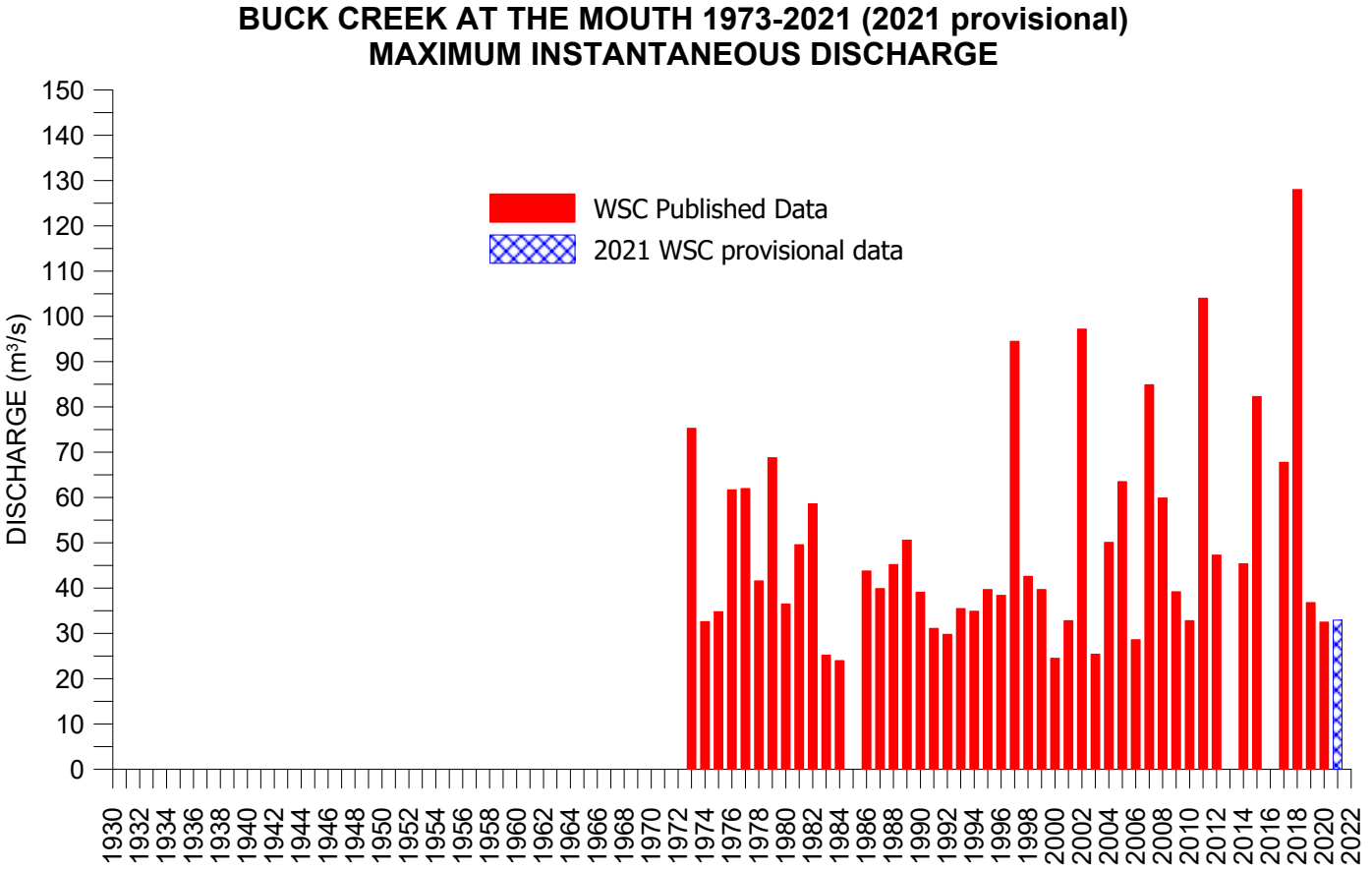
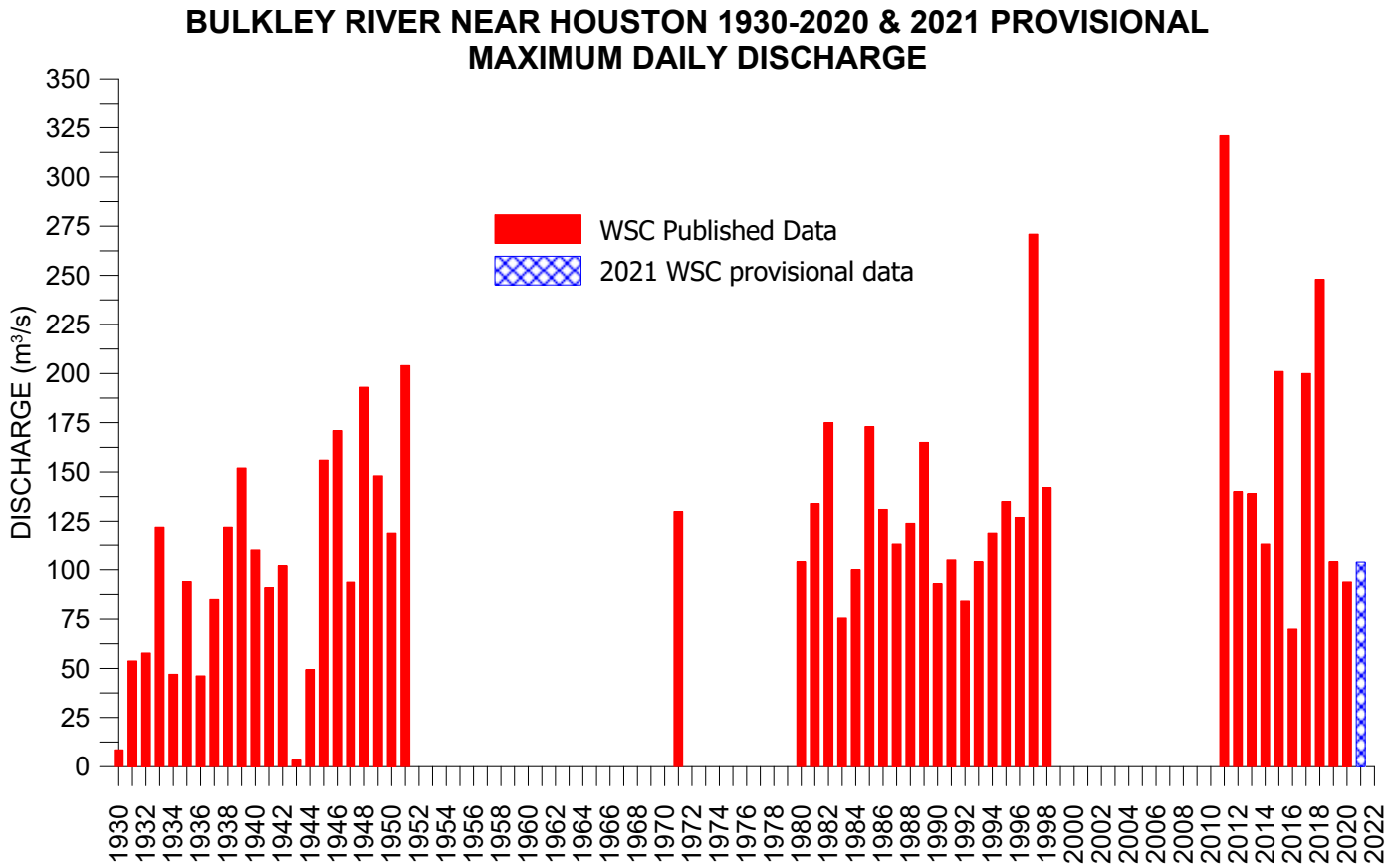


Figure 4.7: Historical variation in annual maximum daily and instantaneous discharge, Buck Creek at the Mouth, 1973 to 2021 (2021 provisional).



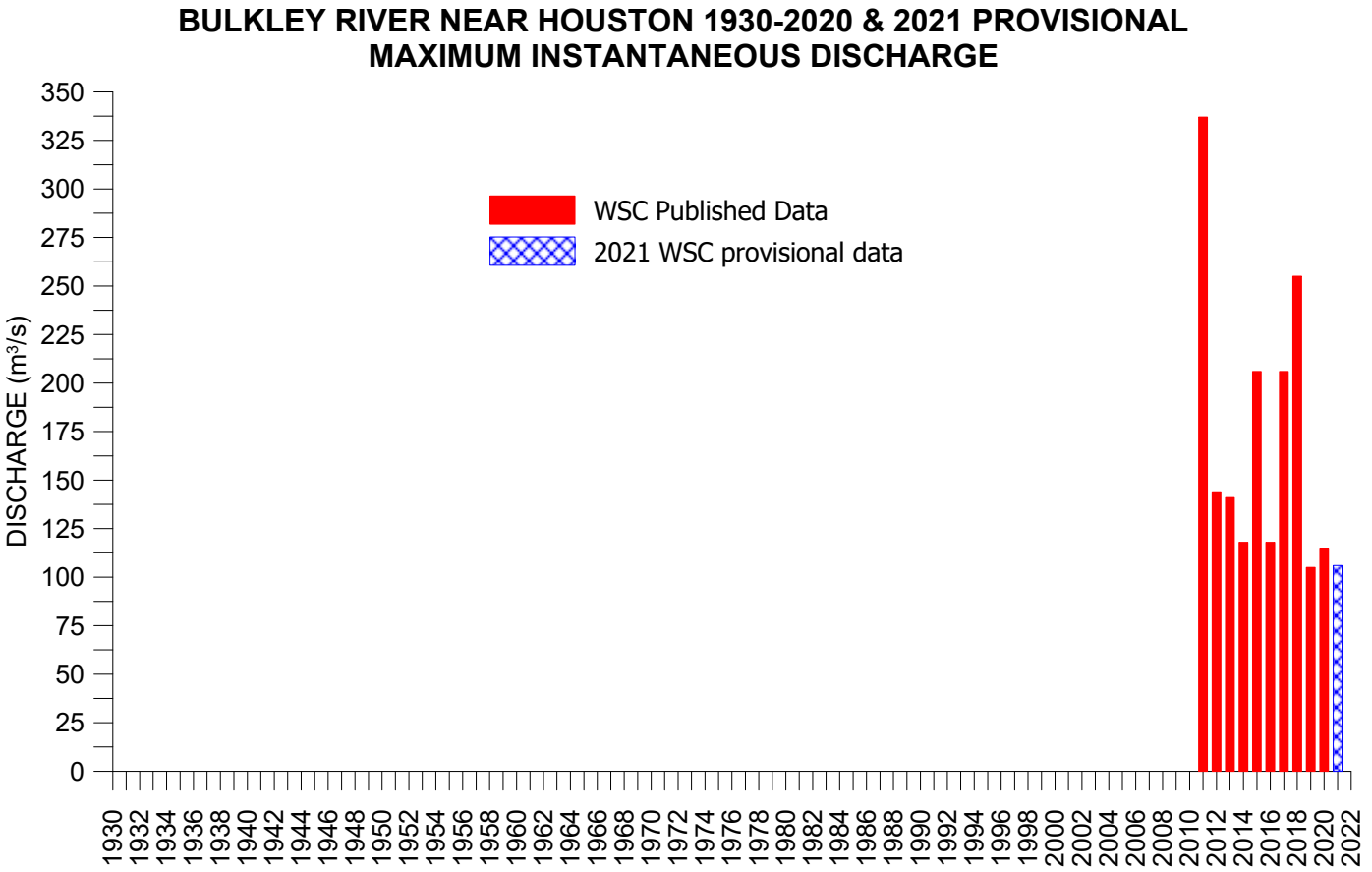


Figure 4.8: Historical variation in annual maximum daily and instantaneous discharge, Bulkley River near Houston, 1930 to 2021 (2021 provisional).

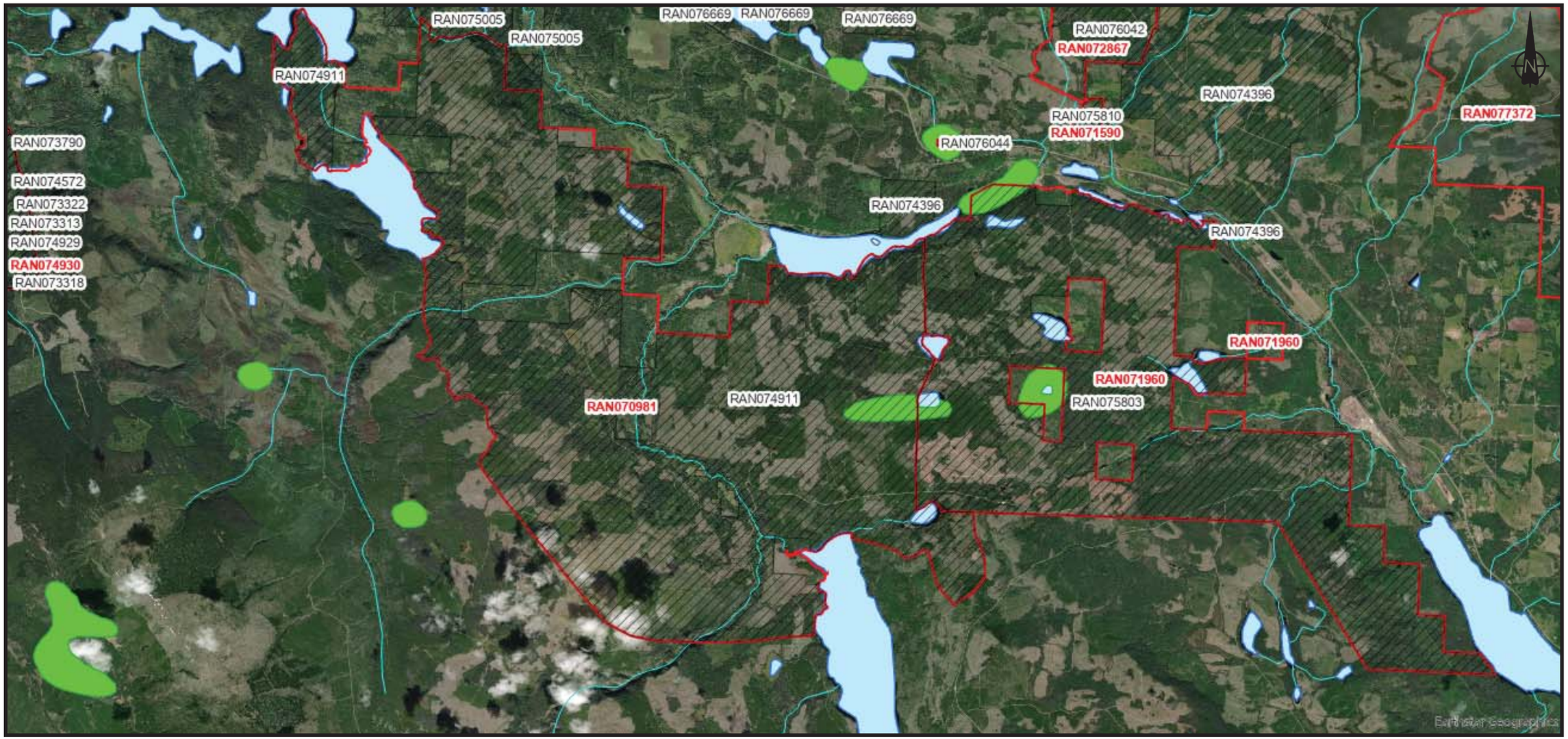


Figure 5.1: Range tenure map (provided by FLNRORD).

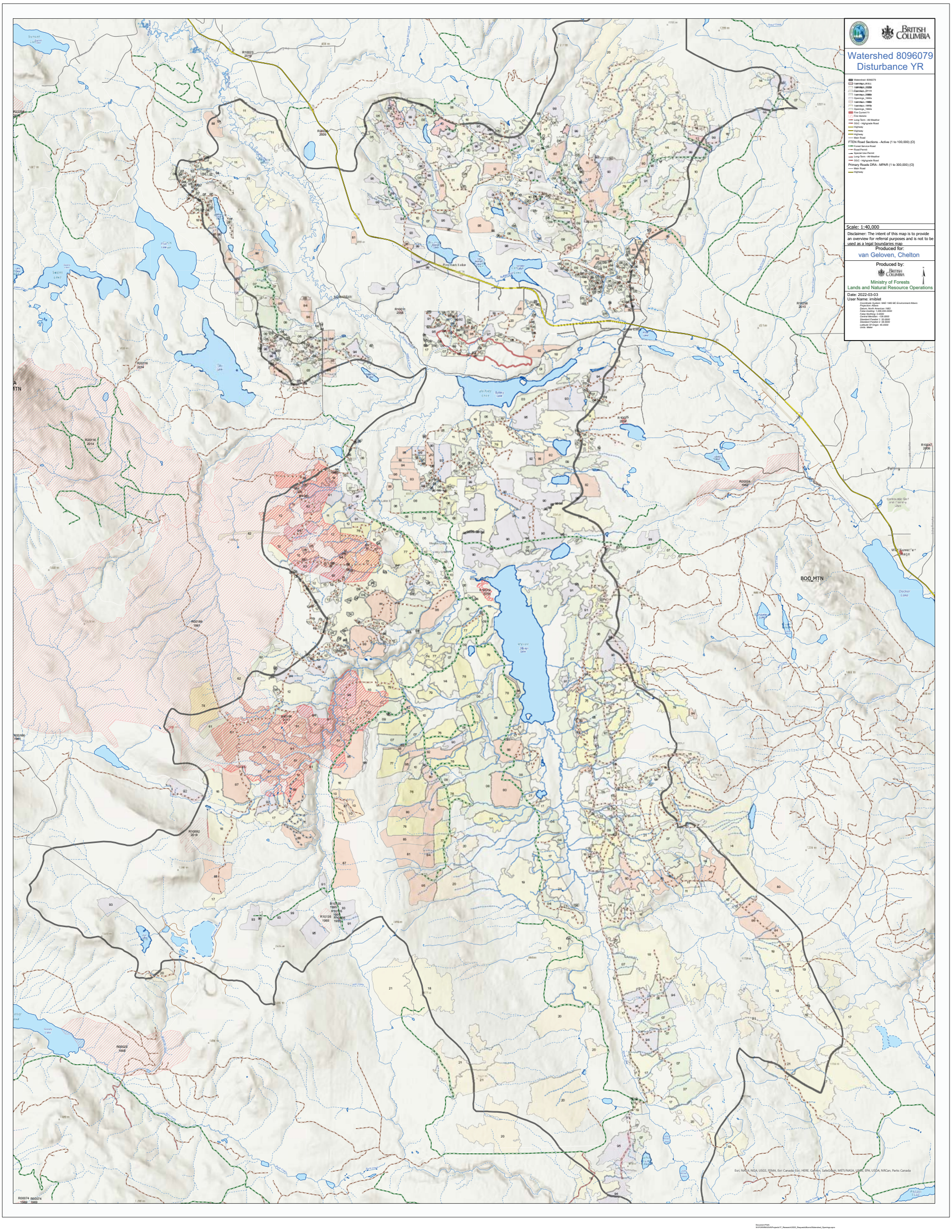


Figure 5.2: Forest harvesting map (provided by FLNRORD).

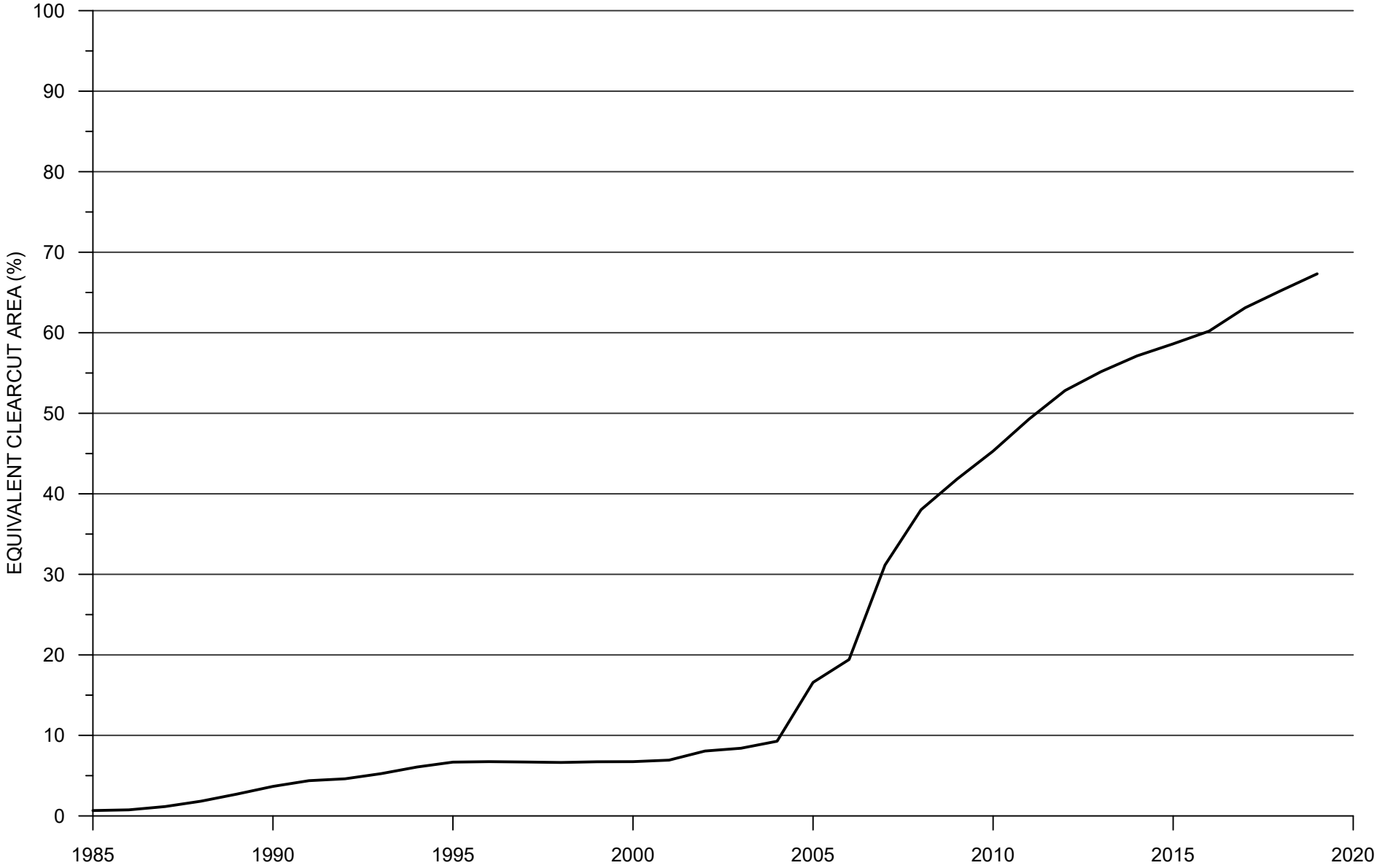


Figure 5.3: Post 1985 initial equivalent clearcut area (ECA) values, Maxan Creek at the confluence with Bulkley Lake. (Data provided by Foundry Spatial, 2021).