# Tomogonops River

## Atlantic Salmon Conservation Strategy

## 2022

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## Acknowledgements

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## Executive Summary

In 2022, the Miramichi River Environmental Assessment Committee (MREAC) was supported by the Atlantic Salmon Conservation Foundation (ASCF) to prepare an Atlantic salmon conservation strategy for the Tomogonops River, which is a tributary to the Northwest Miramichi River. MREAC staff and volunteers completed significant environmental monitoring and habitat assessments during the open water season of 2022. A significant history of industrial impact is available for this drainage basin as part of its headwaters were the receiving waters of mine-influenced flow of the Heath Steele base metal mining and milling operation. The impact of acid mine drainage was problematic for Atlantic salmon and other species in the receiving streams. The significant remediation efforts and recovery subsequent to this damage have been monitored and reviewed. With available data, visual observations, river monitoring, and communication with river stakeholders, it appears that the Tomogonops River has recovered from these mining impacts. The waterway continues to receive third-party monitoring because of this history. Collection and treatment of acidic waters draining from the former mine footprint will continue into the foreseeable future.

Limiting factors to Atlantic salmon production are herein identified and, where possible, addressed with a remediation strategy. Some natural limiting factors will be insurmountable. Future efforts should concentrate on maintaining the existing ecological values that sustain the existing stock of Atlantic salmon and other indigenous fish species. This and other comparable sized tributaries in eastern New Brunswick should be assessed further to determine the actual size of the annual spawning population. Resource protection should be enhanced as human resources allow.

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# 1.0 Introduction

The Miramichi River Environmental Assessment Committee (MREAC) *Tomogonops River Atlantic Salmon Conservation Strategy* was monetarily supported by the Atlantic Salmon Conservation Foundation (ASCF) in 2022. Based on available survey data, recent monitoring efforts, other research, and opportunistic interviews, MREAC herein presents the *Tomogonops River Atlantic Salmon Conservation Strategy*.

The Tomogonops River drainage basin is a stream order 4 and covers an area of 166.3 km² (Figure 1). It is known to have an Atlantic salmon population, but little is known about the size or sustainability of this population.

From the river's mouth where it empties into the Northwest Miramichi the main branch of the Tomogonops extends 5 kilometers upriver until it splits into the North Branch Tomogonops River and South Branch Tomogonops River. Another tributary, the Little South Branch Tomogonops River is significant for two reasons: first it has a sizable drainage area and second, this waterway receives some of the drainage of the now closed and decommissioned Health Steele mine site. The Little South Branch is tributary to the North Branch. From Tomogonops Lake - headwaters of the North Branch - to the river's mouth on the Northwest Miramichi the meander length is 28.1 km.

A MREAC canoe team was able to survey 13.3 kilometers on the North Branch from the Spur Line to the river mouth during high flow conditions on May 13, 2022. Most of the open water season does not allow for canoe passage due to low water levels. In May the water was fast flowing with many long rapid reaches and relatively few pools or steadies. It was noted that there is very limited access to the river, even by woods roads. This isolation is no doubt part of the reason for a low level of angling effort.

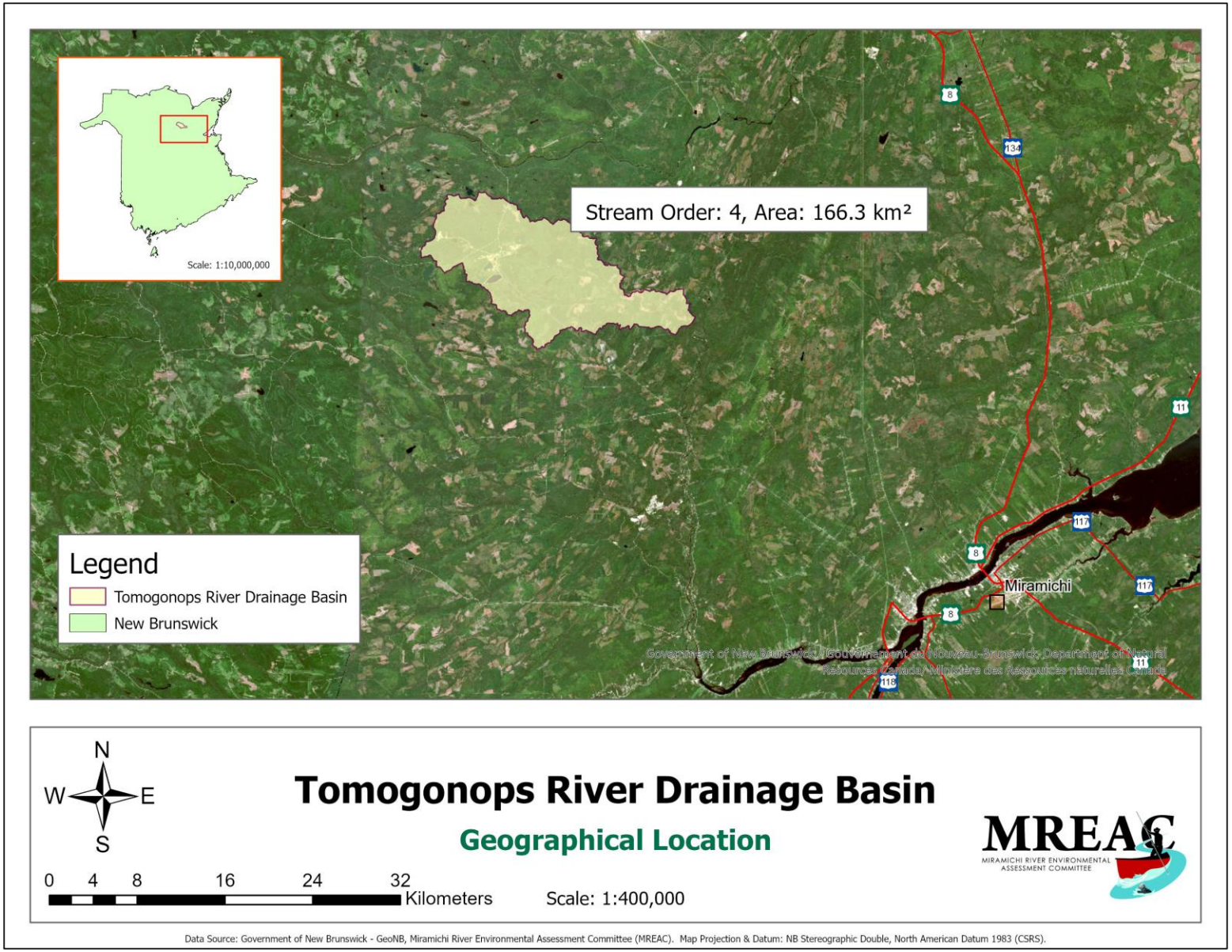


*Figure 1 Tomogonops River Drainage Basin Geographical Location*

MREAC staff and volunteers were able to complete several field work assignments in 2022 including seasonal temperature monitoring at five locations, two river reaches assessed using a fish habitat assessment protocol, two suites of water samples taken for general chemistry analysis and metals, and hand-held monitoring equipment capturing data on dissolved oxygen, pH, conductivity, and temperature. The canoe run in the spring from the Spur Line to the mouth of the Tomogonops provided a river reconnaissance (Figure 2). The field work contributed to habitat assessment and collected data contributed to the overall conservation strategy.

*Figure 2 North Branch Tomogonops River Culverts at Spur Line*

The Miramichi River watershed with her many tributaries remains an important refuge for Atlantic salmon in New Brunswick, Canada. The Tomogonops River watershed has a low profile among the multiple branches of the Miramichi system. The Tomogonops River is tributary to the Northwest Miramichi, which is currently producing fewer Atlantic salmon than the Southwest and the Little Southwest Miramichi river branches. All Miramichi branches have suffered significant declines over the past decades.

The Tomogonops has little profile as an Atlantic salmon angling destination and has received very little attention in salmon management. Relatively little is known about the level of salmon angling other than it is low. The river's potential for producing Atlantic salmon as linked to the production of the Northwest Miramichi River which is currently low.

MREAC undertook this Atlantic salmon conservation strategy on the Tomogonops with hopes of protecting and improving salmon productivity on this remote tributary. Field work involving temperature monitoring, river reconnaissance, habitat assessment, electro-fishing, a redd count and water quality monitoring was completed to contribute to this strategy. The report does consider the river's limiting factors, approaches to sustain the existing level of salmon production, and the prospect of enhancing that production.

The Tomogonops River does have resident Atlantic salmon as shown in the most recent monitoring report commissioned by Glencore, 2015, when during electrofishing juvenile salmon were captured on the Little South Branch Tomogonops.

As with other waterways of this scale in eastern New Brunswick the Tomogonops River has a fall run of spawning salmon. It is apparent that there is little pressure on this stock from recreational fishers due to the lateness of this run and the relatively few fish involved.

During field surveys, approximately 13 kms of the approximate 28 km length of the North Branch Tomogonops and Tomogonops main branch was covered by canoe. The habitat assessment reaches and water quality sampling were completed by wading.

## 2.0 Conservation Strategy Objectives for Atlantic Salmon on the Tomogonops River

1. To maintain the ecological and existing recreational fishing values that the Tomogonops currently possesses.
2. To conserve and protect existing Atlantic salmon stocks and their habitat.
3 To maintain and ensure access to existing recreational fishing opportunities and experiences.
4. To promote the cooperation and support of recreational users, stakeholders and other interested parties to promote effective management of the recreational fisheries resources.
5. To promote equity and fairness for all users in the application of management measures for the recreational fisheries.
6. To present a long-term strategy to conserve and maintain recreational fishes and their habitat on the Tomogonops River.

## 3.0 River Setting & Access

The Tomogonops drainage basin lies in Northeastern New Brunswick and covers 166.3 $km^2$ (Figure 1). The basin contains the relatively short main branch and three significant tributaries. In order of longest to shortest these are; the North Branch Tomogonops, South Branch Tomogonops and Little South Branch.

Most of the land-base on the Tomogonops is New Brunswick Crown Land. Of this almost all is under lease-hold management by the Chaleur Forest Products Inc. (Figure 15).

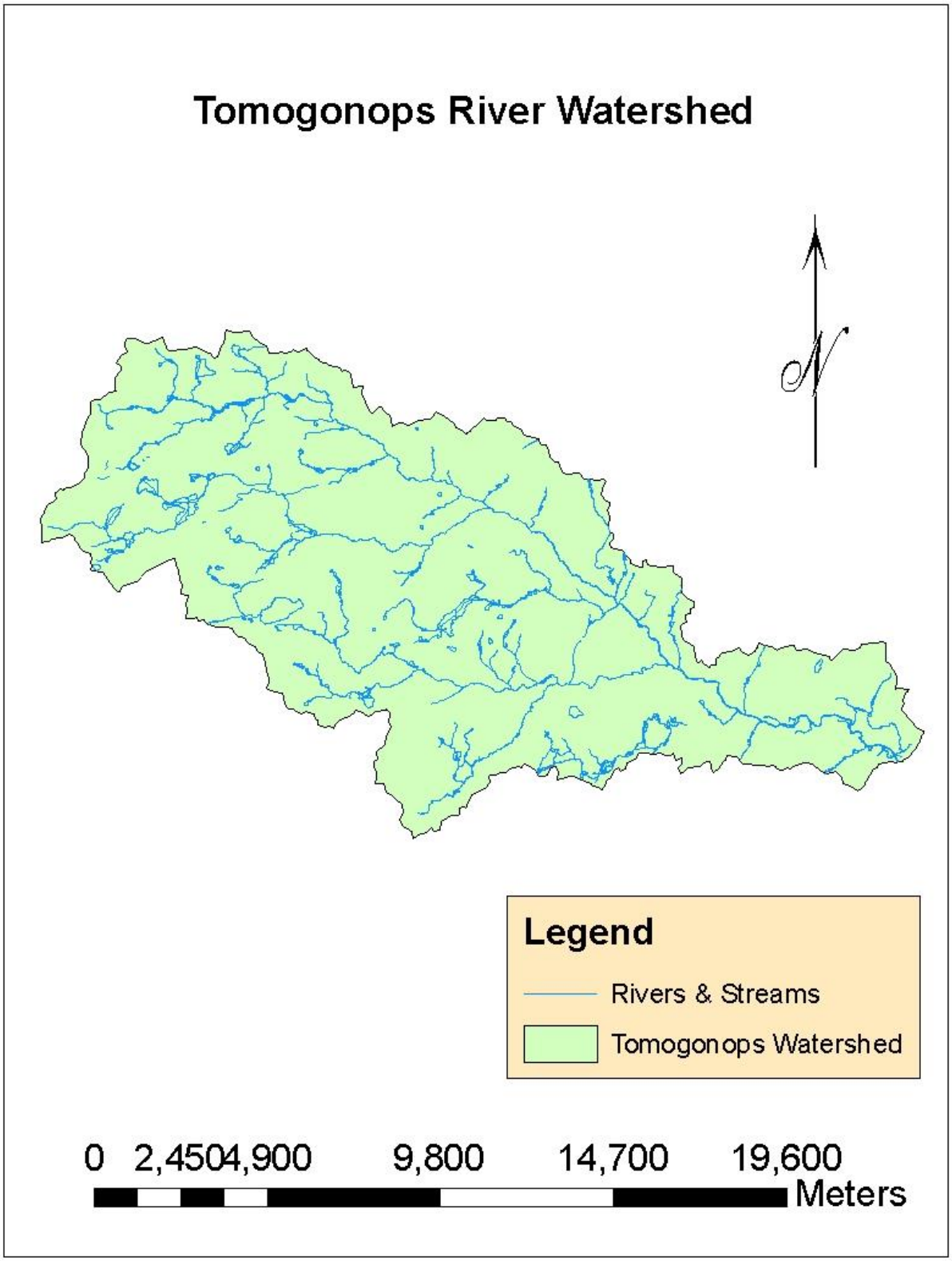


*Figure 3 Tomogonops River Drainage Basin*


*Figure 4 Tomogonops River During Spring River Reconnaissance*

## 4.0 Physical Setting & Climate

In 2022, conditions were wetter and cooler than the record-breaking drought and heat of 2020. Miramichi climate normals (1971-2000) show a mean July temperature of 19.2°C and a mean January temperature of -10.7°C. The mean annual precipitation is 1,115 mm and the drainage basin receives an annual 1993.4 total hours of sunshine (Environment Canada, 2013).
The past two decades have shown that summer temperatures are on the rise, and this is in keeping with the expected climate change scenario. The rainfall amounts have been more erratic but have tended to be drier.

The Tomogonops River drainage basin is almost entirely within the Northern Uplands Ecoregion. The mouth of the Tomogonops River as it empties into the Northwest Miramichi River touches upon the Eastern Lowlands Ecoregion (Figure 5). The river has a high gradient of 10.2 m per kilometer.

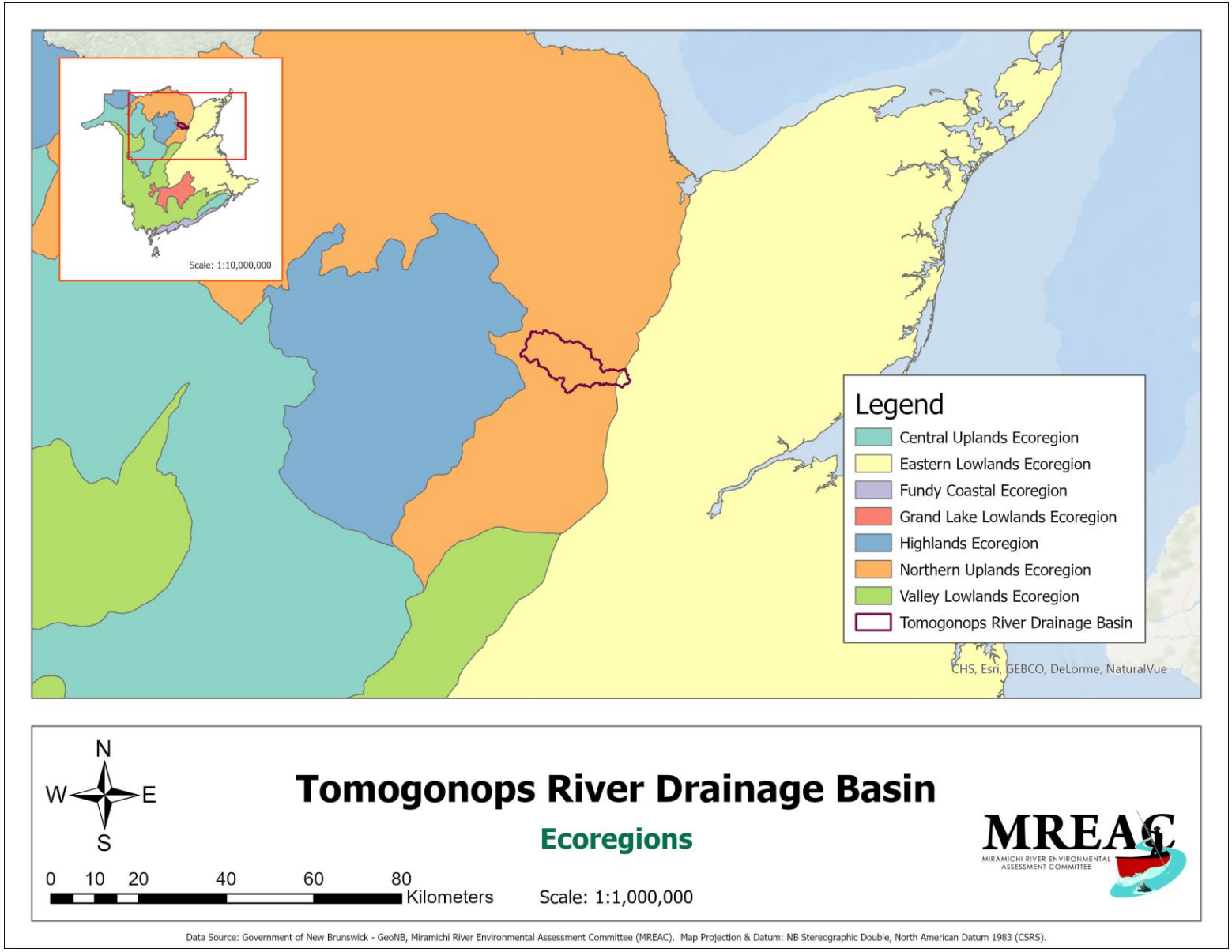


*Figure 5 Tomogonops River Drainage Basin Within New Brunswick Ecoregions*

## 5.0 Land Cover & Land Use

The predominant land cover within the Tomogonops watershed is forest at 69.7% with 50% coniferous tree cover. Regenerating forest comprise another 16.4% of the landscape. Forestry is by far the main economic activity on the watershed and has the greatest anthropogenic impact on the watershed. Forest harvesting is industrial scale under leasehold by Chaleur Forest Products Ltd. who manage 93.1% the crown lands. Forest is followed by the few other land covers as shown in Figure 6.

As noted, mining has had significant impact on Tomogonops River streams and rivers prior to decommissioning and site remediation. The ongoing treatment of acid mine drainage is expected to continue in perpetuity. Since the mine closure, these measures have mitigated the impacts of the historical mining on this waterway.

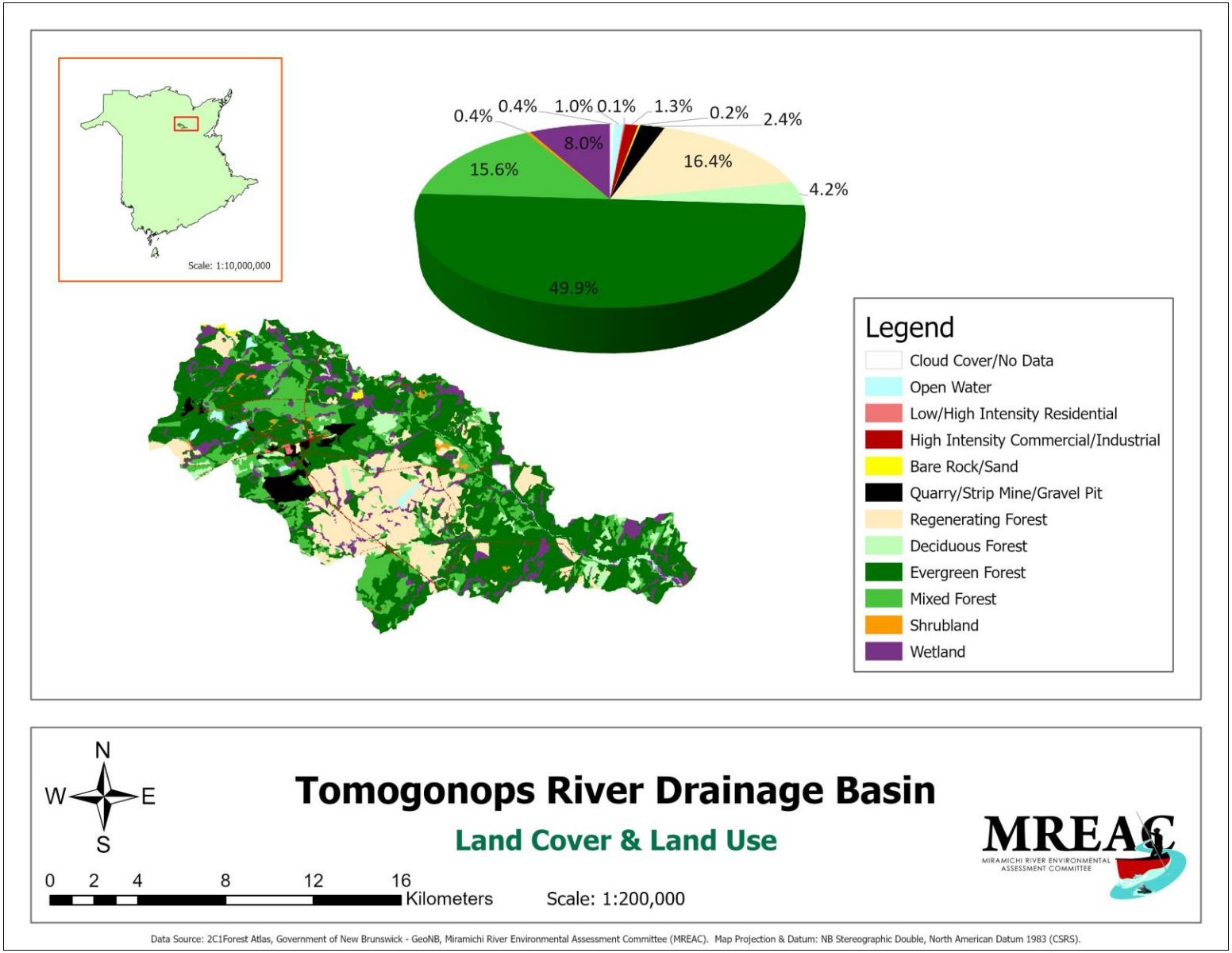


*Figure 6 Tomogonops River Drainage Basin Land Cover & Land Use*

## 6.0 Beaver Dams

Beaver may well be the dominant managers of hydrology on the Tomogonops River. Apart from the largest branches on the Tomogonops, (main branch of Tomogonops and North Branch Tomogonops) other smaller scale tributaries seem well suited to host beaver lodges. The barriers beaver create to fish passage are likely to be the dominant limitation to spawning. Biologist Rod Currie (Hilcon Ltd.) suggests that beaver dams, especially on the smaller branches, may be a limiting factor in salmon distribution throughout otherwise available habitat.

## 7.0 Habitat Assessments

A fish habitat assessment protocol was applied to two one kilometer reaches - one on the main branch, working upstream from the Tomogonops Road crossing, and the second upstream from the Spur Line crossing on the North Branch Tomogonops. These reaches were chosen based on their accessibility and offer representative sections of these waterways. The results of the habitat assessments showed that physical conditions limit spawning potential due to the cobble, rock, and boulder substrate. Figure 7 and Figure 8. Other habitat conditions seem well suited to rearing Atlantic salmon. Using the "DNR&E / DFO, New Brunswick Stream Habitat Inventory", the overall physical characteristics show favorable conditions in the available pools, shade, potential cover with woody debris, bank stability, and vegetation along banks. During the spring canoe run of over 13 km it was noted that there were reaches on the main branch of the Tomogonops that offered good spawning conditions. None were identified on the three other branches.

A redd count survey was conducted in early November 2022 along two kilometers of the North Branch Tomogonops River. No redds were found. This result was attributed to the substrate conditions dominated by cobble, rock, boulder and bedrock. The survey reach sustained a strong current with rapids and riffle conditions throughout, without significant pools. This result has thereby more to do with the habitat conditions along that river reach. Based on our river reconnaissance in the spring and potential barriers caused by beaver, a redd count in the lower reach on the main branch of the Tomogonops River is recommended.

**Recommendation:** *A redd count along the lower five kilometers of the Tomogonops is recommended to get a clearer picture of spawning activity.*

The water temperatures collected from the five monitoring sites (Figure 13) indicate that four of the five temperature loggers briefly reached the a 23°C salmonid thermal stress level. The site at the Spur Line on the North Branch Tomogonops was the exception. The South Branch and Little South Branch were the warmest and second warmest, respectively.

Stress level temperatures for salmonids are now common on most tributaries of the Miramichi. Both high water temperatures and low water quantity favor a fall run when adult salmon are not at risk of temperature stress or exposure to predation. Resident juvenile salmon will typically seek out cold water pools to wait out these conditions.

*Figure 7 Tomogonops River Fish Habitat Survey*

*Figure 8 Fish Habitat Assessment on North Branch Tomogonops*

*Figure 9 Redd Count Survey - North Branch Tomogonops*

One electrofishing site was surveyed on September 15, 2022 on the South Branch Tomogonops River just upstream of the Hwy 430. Hilcon Ltd. (Fredericton) was contracted to complete the electrofishing. This team was led by fish biologist Mr. Rod Currie, supported by his assistant and two MREAC staff.

The electrofishing results were disappointing and produced no juvenile salmon. Hilcon's full report, "2022 Miramichi River Environmental Assessment Committee Fish Population Surveys – South Branch Tomogonops River" is included as Appendix 1. The authors offer the follow insightful observation:

> *"There is likely a significant number of beaver dams throughout the length of this watercourse, including one observed a couple of meters upstream of our sampling area and each dam has the potential to restrict upstream fish passage."*

Brook trout (14) and three other species were collected while electrofishing.

*Figure 10 Electrofishing on the South Branch Tomogonops*

*Figure 11 Brook Trout Captured While Electrofishing – South Branch Tomogonops*

## 8.0 Water Quality

The five temperature loggers were deployed on the Tomogonops at widely distributed locations (Figure 12). These include locations on the three main tributary streams and one on the main branch. Two were placed at crossings on the North Branch Tomogonops, one on the South Branch Tomogonops, one on the Little South Branch Tomogonops and the fifth on the main Tomogonops River near the river's mouth on the Northwest Miramichi. These provide almost five months of temperature data for each of these sites. One of our temperature loggers, located where the Tomogonops passes under the Spur Line, registered cool temperatures consistently below the salmonid thermal stress level. When deployed during the spring freshet it had unknowingly been placed in a side channel near a cold-water source, illustrating the sort of refuge juvenile salmon might find in the heat of the summer. Water quantity is a limiting factor, and between water temperature and water quantity, adult Atlantic salmon arrivals for spawning favor conditions of higher water and cooler temperatures in the fall. Water quality monitoring on the Tomogonops River watershed in 2022 indicated that most parameters show conditions that

are acceptable to support fish populations, including Atlantic Salmon. Appendix 2 shows the general chemistry results taken in 2022. The chemistry sample was processed by the RPC Laboratory (Fredericton). These results were compared to the Canadian Council of Ministers of the Environment's (CCME) Water Quality Guidelines for the Protection of Aquatic Life. No issues were noted.

Figure 14 provides monitoring results from hand-held monitoring devices during various field trips in 2022. These results show generally acceptable conditions related to fish habitat. Significantly, no issues related to pH were recorded on the South Branch Tomogonops or Little South Branch Tomogonops, tributaries that were historically impacted by acid-mine drainage.

Sedimentation issues appear to be minimal; the steep valleys and rough, rocky terrain limit use by off-road recreational vehicles. Forest harvesting requires a 30m buffer zone along waterways. These regulations are being respected.

**Recommendation**: *The Tomogonops River should be included in a comprehensive monitoring program of water temperatures in eastern New Brunswick rivers to monitor long-term trends with the intent of providing special protection of colder water streams and pools as fish refuges.*

**Recommendation:** *Monitoring of the Tomogonops River at the Tomogonops Road site for pH levels should continue annually in late-winter and spring.*

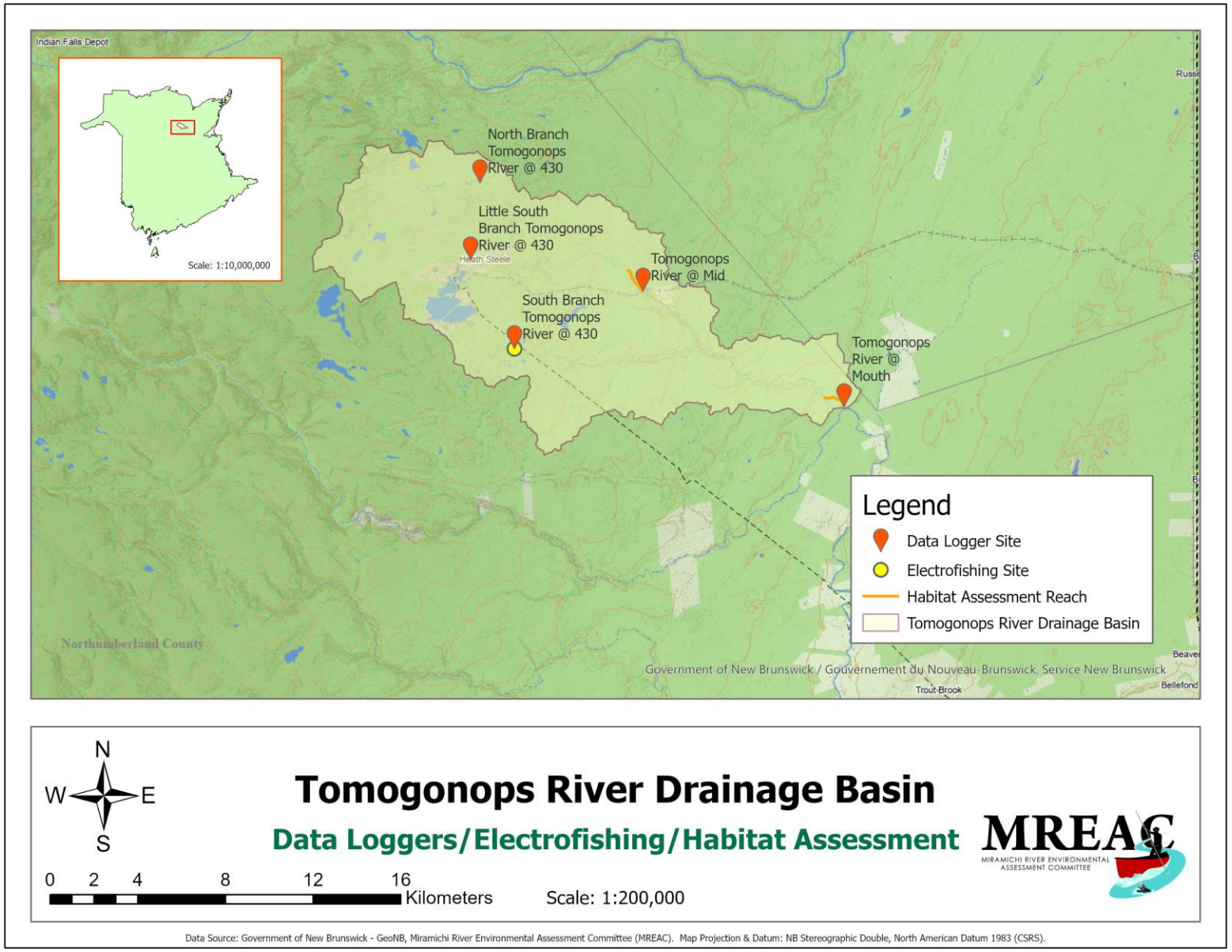


*Figure 12 Tomogonops Watershed Monitoring Sites 2022*

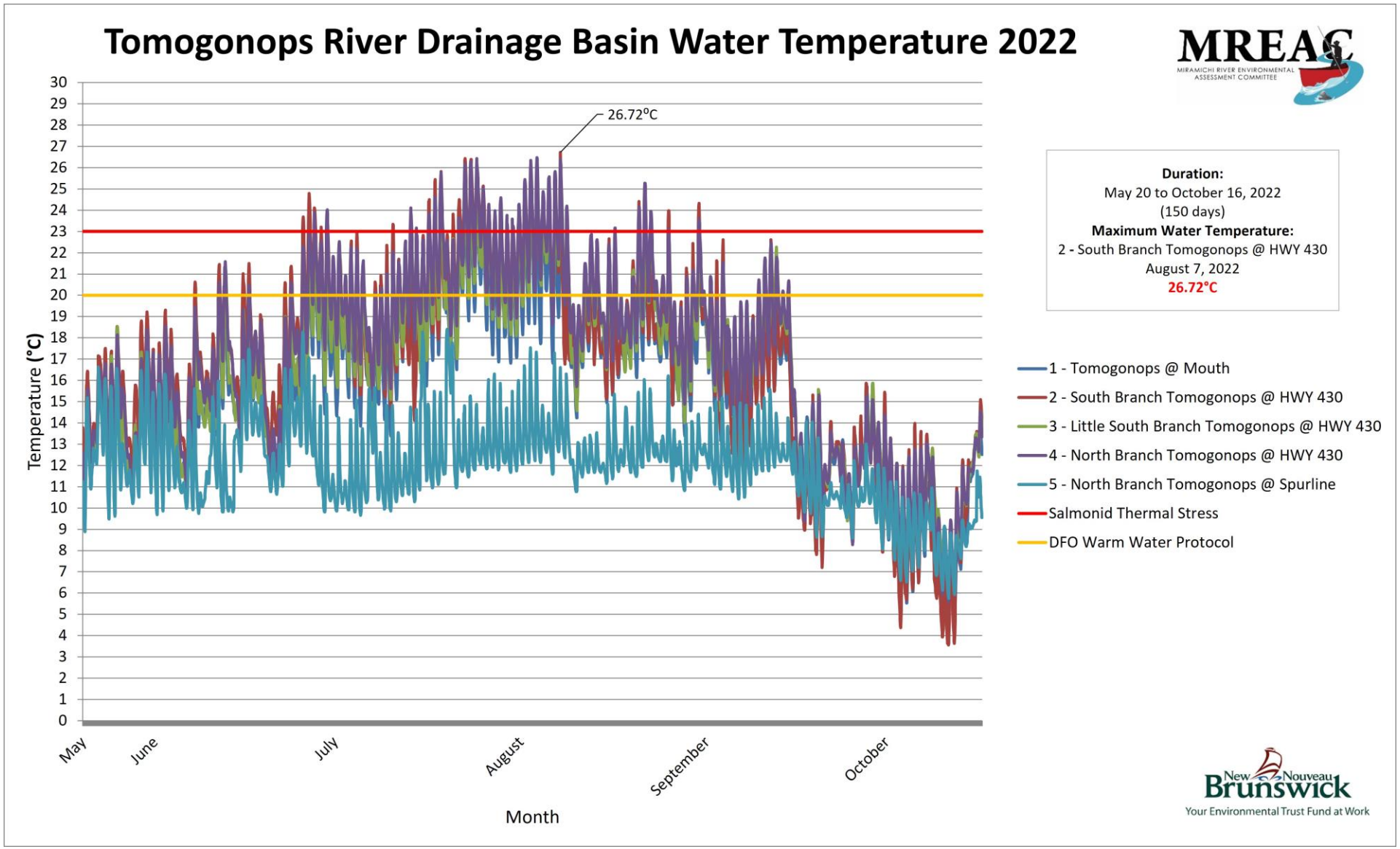


*Figure 13 Composite of Four Temperature Profiles on the Tomogonops Watershed*

| Date | Site | Dissolved Oxygen (mg/l) | Conductivity | Salinity ppt | Temp C° | pH |
|---|---|---|---|---|---|---|
| 13-May-22 | North_South Branch Confluence | | | | 14.7 | 7.41 |
| 13-May-22 | North Branch Tomogonops Feeder | | | | | |
| 13-May-22 | North Branch Tomogonops Feeder | | | | 14.9 | 7.48 |
| 13-May-22 | North Branch Tomogonops | | | | 11 | 7.71 |
| 19-May-22 | South Branch Tomogonops | 10.27 | 584.1 | 0.29 | 9.8 | |
| 19-May-22 | North Branch Tomogonops | 10.67 | 19 | 0.01 | 9.3 | |
| 19-May-22 | Little South Branch Tomogonops | 11.2 | | 0 | 9.6 | |
| 19-May-22 | Tomogonops (main branch at mouth) | 11.9 | 141.8 | 0.4 | 11.8 | |
| 6-Jun-22 | North Branch Tomogonops | 10.93 | 32.1 | 0 | 11.2 | 7.95 |
| 6-Jun-22 | South Branch Tomogonops | 9.82 | 617 | 0.3 | 13.6 | 7.48 |
| 19-Aug-22 | South Branch Tomogonops | 9.59 | 57 | 0.3 | 18.3 | 7.63 |

*Figure 14 Water Quality Sampling Results*

## 9.0 Land Tenure

Most of the land-base on the Tomogonops is New Brunswick Crown Land. Of this, almost all is under lease-hold management by the Chaleur Forest Products Inc. (Figure 15). As one of the large-lease hold operations in New Brunswick this company complies with the code of practice that leaves buffer zones along waterways and wetlands. Throughout this project we found no infractions or out-of-compliance conditions to suggest improper management practices.

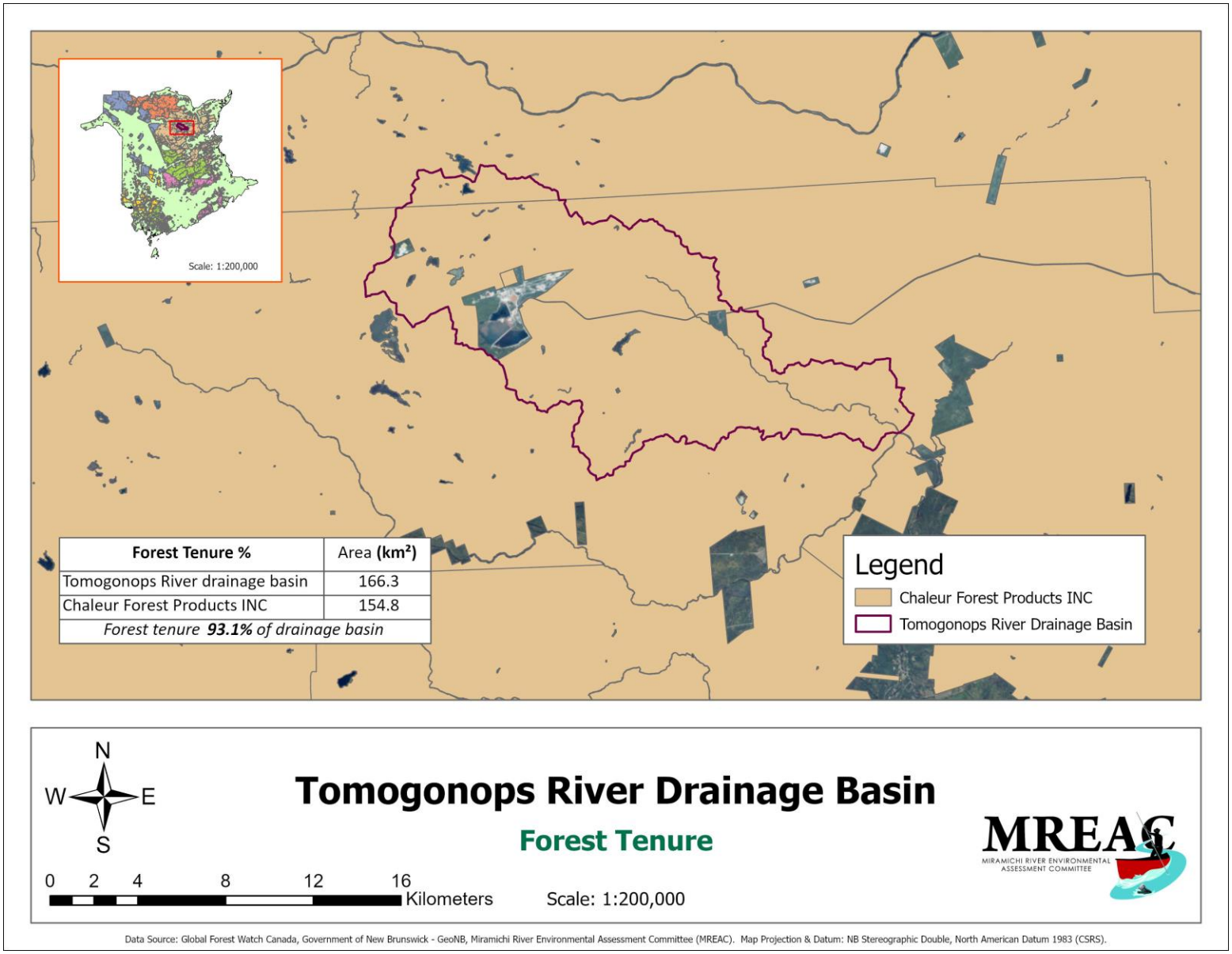


*Figure 15 Tomogonops River Drainage Basin Showing Forest Tenure*

## 10.0 Conclusion

The Tomogonops River sub-watershed is a relatively small, intact waterway with an extant, albeit small Atlantic salmon population. This has much to do with relatively poor Atlantic salmon production on the Northwest Miramichi River over recent years. These poor returns have to do with global conditions, some habitat limitations as well as local challenges of salmon stock management. On the Tomogonops salmon receive limited attention from recreational fishers in favor of Brook trout fishing. The limited fishing pressure on this waterway and other current-day land-uses suggest the Atlantic salmon stock, while small, is not in jeopardy from in-stream threats.

MREAC monitoring on the Tomogonops in 2022 was important to the development of this strategy. This monitoring does not flag any issues related to the historic mining activity on this waterway. While no salmon were found in our electrofishing effort in 2022, salmon are known to occupy the main branches of the Tomogonops based on previous electrofishing efforts. In 2015 juvenile salmon were found in small numbers on the Little South Branch Tomogonops. Salmon distribution and spawning may well be limited by beaver dams in the headwater streams of the Tomogonops.

Climate change impacts, as they increase, will be problematic on this and other eastern New Brunswick waterways. Apart from temperature, good water quality and good habitat conditions suggest the Tomogonops watershed could support a much higher population of Atlantic salmon than it currently does. Limited spawning potential was noted, other than in the five-kilometer reach that constitutes the main branch of the Tomogonops River.

Industrial forestry is the major land use on the Tomogonops River. Mining impacts are now managed in perpetuity, and this is significant for the South Branch Tomogonops as the receiving waters of the Heath Steele drainage. The largely intact riparian zone and relatively narrow channel allows for good shading. The steep gradient and rough substrate results in riffles and rapids contributing to well oxygenated waters.

The current limited pressure from recreational fishers suggest that the existing salmon stock is

secure. Increasing impacts from a warming climate and declining return of spawners to the Northwest Miramichi suggest that the future of a sustainable salmon stock on the Tomogonops over the long-term is in question. Implementing recommendations from this conservation strategy will support the Atlantic salmon stock over the shorter-term. More monitoring is recommended. An active seeding program on the Tomogonops would improve local juvenile abundance on this waterway.

All considered, the future of Atlantic salmon on Miramichi waterways, including the Tomogonops, seem more likely to be determined by more far-reaching factors than the local limiting conditions on this Miramichi tributary.

## 11.0 Summary of Recommendations

**Recommendation**: The Tomogonops River should be included in a comprehensive temperature monitoring program of waterways in eastern New Brunswick rivers to monitor long-term trends.

**Recommendation:** In the recent push to add more protected areas in New Brunswick, the province should consult with stakeholders, including the mining sector and the forest lease holder, to identify a parcel or parcels for protection in the Tomogonops River sub-watershed.

**Recommendation:** Monitoring of the Tomogonops River and her three main branches should occur annually for pH levels, general chemistry, and metals in the spring and fall.

**Recommendation**: The CABIN protocol site on the Tomogonops should be included in a regular monitoring by ECCC to track the ecological condition of the benthic macroinvertebrate population on this waterway.

**Recommendation:** When feasible, the Tomogonops should be assessed using "ARIS Sonar Population Tracking" to determine the actual size of the annual spawning population.

**Recommendation:** Additional electrofishing efforts should be applied to the Tomogonops River and her three main branches to get a better picture of spawning levels on this waterway.

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# Appendix A: Electrofishing Report by R.A Currie Ltd.

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# 2022 Miramichi River Environmental Assessment Committee Fish Population Surveys

South Branch Tomogonops River

| Project Information | |
|---|---|
| **Watercourse** | South Branch Tomogonops River |
| **Survey Completed** | September 15, 2022 |
| **Report Completed** | November 15, 2022 |
| **HILCON Staff** | Clara Thaysen, Rod Currie, and Julia Horncastle |
| **Job No.** | 22075 |

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## INTRODUCTION AND RATIONALE

In 2022, HILCON Limited via R. Currie was contracted by the Miramichi River Environmental Assessment Committee (MREAC) to conduct a fish population survey at the South Branch Tomogonops River within the Miramichi River watershed in northeastern New Brunswick. Surveys are conducted annually at different locations within the Miramichi River watershed in order to maintain long-term data sets of fish species presence and density within watersheds that house Atlantic salmon (*Salmo salar*). The following report summarizes the results of the 2022 survey.

## LOCATION

A fish population survey was conducted at the South Branch Tomogonops River on September 15, 2022. The site was located where Route 430 crosses the Tomogonops on the upstream side of the culvert near Heath Steel Mines, Northumberland County (47.258194, -66.033758). Please see Figure 1 for a map of the location and Figure S1 in the Supplementary Information for an image of the site.

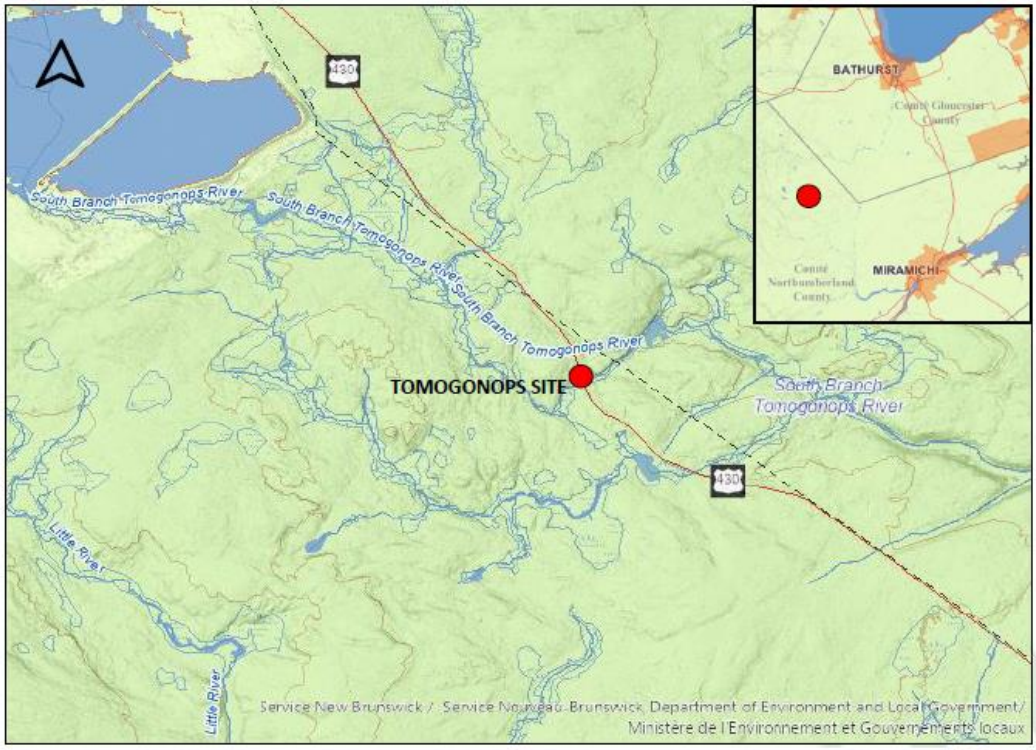


**Figure 1.** Location of 2022 Tomogonops site.



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## METHODOLOGY

The fish sampling methodology followed procedures for the removal method of population estimation for enclosed sites. The limits of the sampling area were marked with nets, then fish were collected from the designated area during four consecutive sweeps using a Smith-Root Model LR24 backpack electrofisher. Electrical settings were selected automatically at each site using the Quick Setup method on the electrofisher. The midday water temperature was measured with a certified pocket thermometer, and the wetted width and length of the site was recorded to determine the sampling site area. To account for meanders in the watercourse, the wetted width was determined by measuring several consecutive width measurements every couple of metres in between the nets and then calculating the average of these measurements. The environmental characteristics and electrofishing settings are summarized in Table S1 in the Supplementary Information.

Electrofishing was conducted by moving back and forth across the stream while gradually moving upstream from the lower boundary towards the upper boundary of the site. Stunned fish were collected by several technicians using dip nets and placed in a pail that was partially filled with water. Following each sweep, fish were lightly anesthetized using tricaine methanesulfonate (TMS), identified to species, and counted. Individual brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*) were additionally measured for fork length, then assigned an age class based on their respective size class. Processed fish were then transferred to a holding cage placed in the stream until the final sweep was completed. When fish from the final sweep were processed, all of the fish were released unharmed back into the watercourse.

Estimates of population density for each species of fish, as well as for each age class of salmon and trout, were generated using the *Microfish 3.0* formula (Van Deventer and Platts, 1989). The density estimates were then adjusted based on the size of the site to achieve a standard unit area of 100 $m^2$ to permit the direct comparison of fish densities between sites and between years if sites are revisited in the future.

## RESULTS AND DISCUSSION

The density estimates from the population survey are presented in Table 1. The individual counts for each fish, including fork length measurements for salmonids can be found in Tables S2 and S3, respectively, in the Supplementary Information.

**Table 1.** Species density estimates.

| Species | Age | Number/100 $m^2$ |
|---|---|---|
| **Brook trout** (*Salvelinus fontinalis*) | 0+ | 5.4 |
| | 1+ | 0.4 |
| | All age classes | 5.8 |
| **Blacknose dace** (*Rhinichthys atratulus*) | | 63.6 |
| **Creek chub** (*Semotilus atromaculatus*) | | 2.5 |



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The Tomogonops River is a tributary of the Northwest Miramichi River. One of the sub-drainages of this system, the South Branch Tomogonops River, drains an area on the south side of the Heath Steele mine. In the 1960s, through a series of misfortunes, this branch was subjected to an inflow of acid mine drainage for the mine property. This contamination killed biota throughout the length of the Tomogonops River, and had the added effect of repelling salmon migration in the NW Miramichi River and forcing those fish to seek spawning areas in other tributaries downstream of the confluence of the Tomogonops drainage. The mine has since closed operations and extensive rehabilitation projects were undertaken to recover waste rock and reduce acid generation. Environmental monitoring has been conducted over the years and have shown continuous improvements to fish and benthic invertebrate communities.

The 2022 fish population survey at the South Branch Tomogonops River found four species of fish inhabiting riffle habitat (Figure S1): brook trout (*Salvelinus fontinalis*), blacknose dace, (*Rhinichthys atratulus*), white sucker (*Catostomus commersonii*), and creek chub (*Semotilus atromaculatus*) (Table S2). Blacknose dace were the most abundant species with a population estimate of 63.6 dace per 100 m² (Table 1). Blacknose dace are a very common species throughout the province and the density of dace at this location is similar to densities observed at other locations. The second most abundant fish species was brook trout with a total density estimate of 5.8 trout per 100 m² (Table 1). As expected, brook trout fry (age class 0+) make up the majority of the brook trout community, with the remainder being a single yearling (Table S2). The density of brook trout at this location is low in comparison to trout communities in this general area of the province: for example, similar fish population surveys at a number of small tributaries of the Nepisiguit River have shown brook trout densities to exceed 100 individuals per 100 m² (R. Currie, personal communication). The final fish species to be captured in the 2022 fish survey on the South Branch Tomogonops River was creek chub which was found in low numbers (2.5 chub/100 m²; Table 1). This is a common fish species that occurs throughout the province. White sucker was erroneously omitted from the density measurements and thus is not discussed. Only one white sucker was found.

The fact that no Atlantic salmon were captured in this survey is disappointing but perhaps not surprising, as these results are not dissimilar to results from earlier environmental effects monitoring surveys. The presence of various ages/sizes of other species of fish suggests that the current quality of water in the South Branch Tomogonops River is suitable to sustain those species. If water quality is not the limiting factor, then perhaps the location of the sampling site in the upper end of this waterway may be the problem. There is likely a significant number of beaver dams throughout the length of this watercourse, including one observed a couple of meters upstream of our sampling area, and each dam has the potential to restrict upstream fish passage.



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It is also important to note that the salmon population in the NW Miramichi River system as a whole is currently experiencing very low densities of juvenile and adult fish (R. Currie, personal communication). The reasons for the low salmon numbers are varied and include excessive predation of migrating smolts by striped bass (*Morone saxatilis*) in the Miramichi estuary, and as-yet unexplained elevated mortality occurring at sea (Daniels et al., 2018). All of these factors result in reduced numbers of spawning salmon in this system. This would suggest that there is little competition for salmon spawning habitat which could mean that the low numbers of fish are simply selecting alternate, more accessible spawning habitat.

**CONCLUSION**

In summary, the 2022 fish population survey performed at the South Branch Tomogonops River was completed successfully. Please contact myself, Clara Thaysen, if you have any questions about this report.

Thank you,

Clara Thaysen, M.Sc.
Ecologist
(647) 456-3358
clara.thaysen@hilcon.ca



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## REFERENCES

Daniels J., Chaput, G., and Carr, J. 2018. Estimating consumption rate of Atlantic salmon smolts (*Salmo salar*) by striped bass (*Morone saxatilis*) in the Miramichi River estuary using acoustic telemetry. Canadian Journal of Fisheries and Aquatic Sciences (11): 1811-1822. https://doi.org/10.1139/cjfas-2017-0373.

R. Currie, personal communication. November 2022.

Van Deventer, J.S., and Platts, W.S. 1989. Microcomputer software system for generating population statistics from electrofishing data : user's guide for MicroFish 3.0. General Technical Report INT-254. United States Department of Agriculture, Forest Service, Intermountain Research Station: Ogden, Utah.



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## SUPPLEMENTARY INFORMATION

**Table S1.** Electrofisher settings and environmental characteristics for the 2022 Tomogonops site. Voltage was maintained for all sweeps. Other settings on the unit were maintained at their default levels: pulse width = 6 milliseconds, and frequency = 40 hertz.

| Voltage (V) | Electrofisher on-time (s; sweep 1, 2, 3, 4) | Water temperature (°C) | Average wetted site width (m) | Site length (m) | Area of sampling site ($m^2$) |
|---|---|---|---|---|---|
| 130 | 1332, 1468, 1067, 1242 | 12.0 | 4.7 | 46.2 | 217.1 |

**Table S2.** Individual species counts for the 2022 Tomogonops site.

| Species | Age | Number of individuals |
|---|---|---|
| **Brook trout** (*Salvelinus fontinalis*) | 0+ | 13 |
| | 1+ | 1 |
| | ***Total*** | ***14*** |
| **Blacknose dace** (*Rhinichthys atratulus*) | | 148 |
| **Creek chub** (*Semotilus atromaculatus*) | | 6 |
| **White sucker** (*Catostomus commersonii*) | | 1* |

* White sucker was erroneously omitted from the density calculations. We include the number count here for transparency.

**Table S3.** Individual salmonid fork length measurements for each 2022 site.

| Species | Age | Fork length (mm) |
|---|---|---|
| **Brook trout** (*Salvelinus fontinalis*) | 0+ | 48 |
| | | 50 |
| | | 52 |
| | | 57 |
| | | 57 |
| | | 58 |
| | | 59 |
| | | 60 |
| | | 60 |
| | | 62 |
| | | 66 |
| | | 71 |
| | | 72 |
| | 1+ | 126 |
| | ***Total individuals*** | ***14*** |



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**Figure S1.** South Branch Tomogonops River sampling site on September 15, 2022.

# Appendix B: Water Chemistry Results 2022

Report ID: 463796-IAS
Report Date: 10-Nov-22
Date Received: 03-Nov-22

# CERTIFICATE OF ANALYSIS

for
Miramichi River Environmental
Assessment Committee
21 Cove Road
Miramichi, NB E1V 0A6

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Harry Collins
**Project #: Not Available**
Location: North Branch Tomogonops River

**Analysis of Surface Water**

| RPC Sample ID: | | | 463796-1 |
|---|---|---|---|
| Client Sample ID: | | | 17/22/03087 Tomogonops River @ Tomogonops Road |
| Date Sampled: | | | 2-Nov-22 |
| **Analytes** | **Units** | **RL** | |
| Sodium | mg/L | 0.05 | 1.60 |
| Potassium | mg/L | 0.02 | 0.51 |
| Calcium | mg/L | 0.05 | 19.1 |
| Magnesium | mg/L | 0.01 | 1.70 |
| Alkalinity (as $CaCO_3$) | mg/L | 2 | 22 |
| Chloride | mg/L | 0.5 | 1.5 |
| Fluoride | mg/L | 0.05 | 0.26 |
| Sulfate | mg/L | 1 | 38 |
| Bromine | mg/L | 0.01 | < 0.01 |
| Ammonia (as N) | mg/L | 0.05 | < 0.05 |
| Un-ionized @ 20ºC | mg/L | - | < 0.001 |
| Nitrate + Nitrite (as N) | mg/L | 0.05 | < 0.05 |
| Nitrite (as N) | mg/L | 0.05 | < 0.05 |
| Nitrate (as N) | mg/L | 0.05 | < 0.05 |
| Nitrogen - Total | mg/L | 0.2 | 0.2 |
| Phosphorus - Total | mg/L | 0.002 | 0.011 |
| Carbon - Total Organic | mg/L | 0.5 | 6.1 |
| Colour | TCU | 5 | 45 |
| Conductivity | µS/cm | 1 | 134 |
| pH | units | - | 7.5 |
| Turbidity | NTU | 0.1 | 0.6 |
| | | | |
| **Calculated Parameters** | | | |
| Bicarbonate (as $CaCO_3$) | mg/L | - | 21.9 |
| Carbonate (as $CaCO_3$) | mg/L | - | 0.065 |
| Hardness (as $CaCO_3$) | mg/L | 0.2 | 54.7 |
| TDS (calc) | mg/L | - | 82 |
| Saturation pH (20°C) | units | - | 8.7 |
| Langelier Index (20°C) | - | - | -1.22 |

This report relates only to the sample(s) and information provided to the laboratory.

RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

Brannen Burhoe
Supervisor
Inorganic Analytical Services

Report ID: 463796-IAS
Report Date: 10-Nov-22
Date Received: 03-Nov-22

# CERTIFICATE OF ANALYSIS

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Assessment Committee
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Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Harry Collins
**Project #: Not Available**
Location: North Branch Tomogonops River

**Analysis of Surface Water**

| RPC Sample ID: | | | 463796-1 |
|---|---|---|---|
| Client Sample ID: | | | 17/22/03087 Tomogonops River @ Tomogonops Road |
| Date Sampled: | | | 2-Nov-22 |
| **Analytes** | **Units** | **RL** | |
| Aluminum | mg/L | 0.001 | 0.047 |
| Antimony | mg/L | 0.0001 | < 0.0001 |
| Arsenic | mg/L | 0.001 | < 0.001 |
| Barium | mg/L | 0.001 | 0.005 |
| Beryllium | mg/L | 0.0001 | < 0.0001 |
| Bismuth | mg/L | 0.001 | < 0.001 |
| Boron | mg/L | 0.001 | 0.002 |
| Cadmium | mg/L | 0.00001 | 0.00002 |
| Calcium | mg/L | 0.05 | 19.1 |
| Chromium | mg/L | 0.001 | < 0.001 |
| Cobalt | mg/L | 0.0001 | < 0.0001 |
| Copper | mg/L | 0.001 | 0.002 |
| Iron | mg/L | 0.02 | 0.11 |
| Lead | mg/L | 0.0001 | 0.0002 |
| Lithium | mg/L | 0.0001 | 0.0003 |
| Magnesium | mg/L | 0.01 | 1.70 |
| Manganese | mg/L | 0.001 | 0.020 |
| Molybdenum | mg/L | 0.0001 | 0.0001 |
| Nickel | mg/L | 0.001 | < 0.001 |
| Potassium | mg/L | 0.02 | 0.51 |
| Rubidium | mg/L | 0.0001 | 0.0009 |
| Selenium | mg/L | 0.001 | < 0.001 |
| Silver | mg/L | 0.0001 | < 0.0001 |
| Sodium | mg/L | 0.05 | 1.60 |
| Strontium | mg/L | 0.001 | 0.026 |
| Tellurium | mg/L | 0.0001 | < 0.0001 |
| Thallium | mg/L | 0.0001 | < 0.0001 |
| Tin | mg/L | 0.0001 | < 0.0001 |
| Uranium | mg/L | 0.0001 | < 0.0001 |
| Vanadium | mg/L | 0.001 | < 0.001 |
| Zinc | mg/L | 0.001 | 0.009 |

Report ID: 463796-IAS
Report Date: 10-Nov-22
Date Received: 03-Nov-22

**CERTIFICATE OF ANALYSIS**
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Fax: 506.452.0594
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**Methods**

| Analyte | RPC SOP # | Method Reference | Method Principle |
|---|---|---|---|
| Ammonia | IAS-M47 | APHA 4500-$NH_3$ G | Phenate Colourimetry |
| pH | IAS-M03 | APHA 4500-$H^+$ B | pH Electrode - Electrometric |
| Alkalinity (as $CaCO_3$) | IAS-M43 | EPA 310.2 | Methyl Orange Colourimetry |
| Chloride | IAS-M44 | APHA 4500-CL E | Ferricyanide Colourimetry |
| Fluoride | IAS-M30 | APHA 4500-F- D | SPADNS Colourimetry |
| Sulfate | IAS-M45 | APHA 4500-$SO_4$ E | Turbidimetry |
| Nitrate + Nitrite (as N) | IAS-M48 | APHA 4500-$NO_3$ H | Hydrazine Red., Derivitization, Colourimetry |
| Nitrite (as N) | IAS-M49 | APHA 4500-NO2- B | Ferrous Ammonium Sulfate Colourimetry |
| Nitrogen - Total | IAS-M57 | ASTM D8083-16 | Combustion/Chemiluminescence |
| Phosphorus - Total | IAS-M17 | APHA 4500-P E | Digestion, Manual Colourimetry |
| Carbon - Total Organic | IAS-M57 | APHA 5310 B | Combustion/NDIR |
| Turbidity | IAS-M06 | APHA 2130 B | Nephelometry |
| Colour | IAS-M55 | APHA 2120 Color (A,C) | Single Wavelength Spectrophotometry |
| Conductivity | IAS-M04 | APHA 2510 B | Conductivity Meter - Electrode |
| Trace Metals | IAS-M01/IAS-M29 | EPA 200.8/EPA 200.7 | ICP-MS/ICP-ES |

Report/Rapport: 463796-ML-W1
Date: 04-Nov-22
Date Received/Reçu: 03-Nov-22

# CERTIFICATE OF ANALYSIS / CERTIFICAT D'ANALYSE

for/pour
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Fredericton NB
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Tel: 506.452.1368
Fax: 506.452.1395
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Attention: Harry Collins / Erin Douthwright

Client Location: North Branch Tomogonops River
Microbiological Examination of Water/Qualité microbiologique de l'eau potable

| RPC Sample ID/No. d'échantillon de RPC: | | | | 463796-1 |
|---|---|---|---|---|
| Client Sample ID/ID d'échantillon du client: | | | | 17/22/03087 Tomogonops River @ Tomogonops Road |
| Date collected/Date du prélèvement | | | | 2-Nov-22 |
| Time sampled/Heure du prélèvement | | | | 2:15:00 PM |
| **Analytes/Paramètre(s)** | **Method/Méthode** | **Date Analyzed Date Analysé** | **Units Unités** | |
| E. coli | FFA10 | 3-Nov-22 | MPN/100mL | 33.1 |

This report relates only to the sample(s) and information provided to the laboratory.
Le présent rapport ne s'applique qu'aux échantillons et à l'information transmis au laboratoire.

Gillian Travis
Microbiology Technician
Applied and Experimental Bioscience



Patrick Beattie
Microbiology Technician
Applied and Experimental Bioscience