Stewardship Plan for the Anagance River:

A Tributary of the Petitcodiac River

Fort Folly Habitat Recovery

Fort Folly First Nation

2024 Edition

Stewardship Plan for the Anagance River:

A Tributary of the Petitcodiac River

Fort Folly Habitat Recovery

Fort Folly First Nation

2024 Edition

Disclaimer:

This document claims no authority by which to drive its implementation. Instead, it is intended simply to serve as a public resource that organizes available information and helps inform future decision making by identifying, and prioritizing needs and sites for restoration activities that will enhance habitat quality and promote species recovery. This is a reference, not intended to be read cover to cover. It is also a living document, current and definitive to the time of writing, but constantly evolving and will never assume an absolute "final" form. Instead, it will be updated and superseded by subsequent editions as additional information becomes available.

Fort Folly Habitat Recovery. (2023). Stewardship Plan for the Anagance River: A Tributary of the Petitcodiac River. Stewardship Plan Series. No. 5. Fort Folly Habitat Recovery, Dorchester New Brunswick. 51 pages.

Contents

Figures

Tables

Introduction

This Stewardship Plan for the Anagance River is one of a series of seven such documents compiling, detailing, and presenting information about tributaries of the Petitcodiac River and surrounding watersheds. The purpose of these documents is to enable prioritization and planning of restoration activities within the following watersheds: 1) Demoiselle Creek, a small watershed that drains directly into Shepody Bay, near the mouth of the Petitcodiac River estuary, 2) the Memramcook River, immediately adjacent to the mouth of the Petitcodiac River at Fort Folly Point, 3) the main stem of the Petitcodiac extending between the Village of Petitcodiac (where the Petitcodiac "begins") down to the head-of-tide at Salisbury, and four tributaries of the Petitcodiac River system, 4) Little River, 5) Pollett River, 6) Anagance River, and 7) the North River. The location of these watersheds in or near the Petitcodiac system, (just outside of Moncton New Brunswick) is presented below in Figure 1. Each watershed was assessed according to the four-level approach laid out in the Department of Fisheries and Oceans document, "Ecological Restoration of Degraded Aquatic Habitats: A Watershed Approach" (Melanson et. al 2006). The first level of assessment is examination of the land use history of the watershed. The second level of

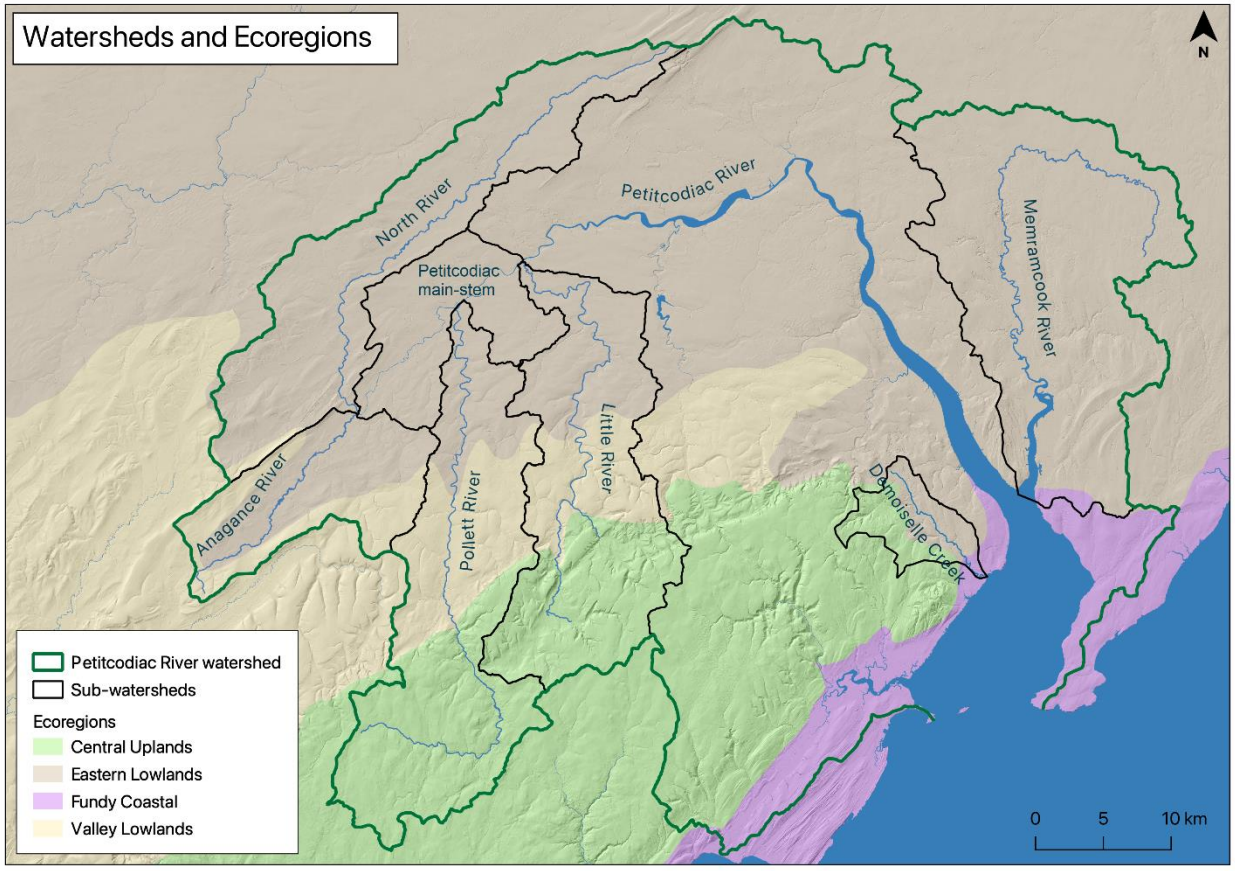

Figure 1: Location of the Anagance River within the Petitcodiac system.

assessment looks at the current impacts. The third level of assessment considers the aquatic and riparian habitat, and the fourth level of assessment brings this information together to develop an aquatic habitat rehabilitation plan that identifies priorities and opportunities for interventions within each watershed to advance habitat restoration.

Anagance River

The Anagance River flows 28.4 kilometers (Pugh 1999) from its headwaters in the eastern end of Kings County down to its confluence with the North River in western Westmorland County (at the Village of Petitcodiac). The point where the two meet marks the beginning of the main stem of the Petitcodiac River (Natural Resources Canada 1997). The Anagance watershed drains 138.9 km^2, making it the 4th largest tributary of the Petitcodiac. It lies mostly within the Eastern Lowlands Ecoregion, though a few points reach sufficient elevation along the ridges marking its boundaries to fall within the Continental Lowlands Ecoregion (Department of Natural Resources 2007). It is slow moving, with a sand and silt substrate (Petitcodiac Watershed Alliance 2016). Much of the river has low gradient, dropping just 25 metres along the 24.7 km between Dunsinane and its mouth (Natural

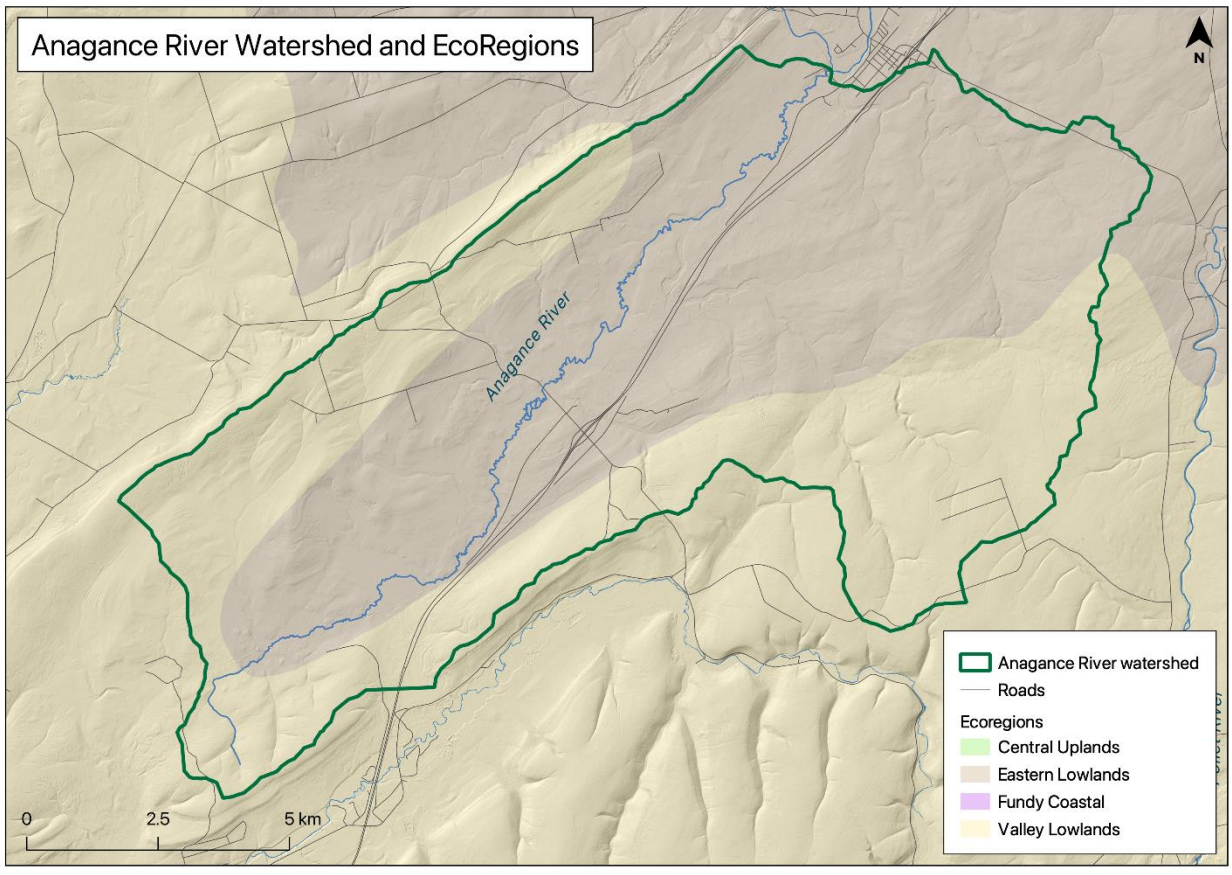

Figure 2: Anagance River watershed.

Resources Canada 1997). It is narrow, convoluted and meandering, with numerous wetlands (cover: top and bottom photos). After the Anagance and the North Rivers meet, the channel (now the main stem of the Petitcodiac River) continues in an easterly direction before bending at Moncton and heading southeast into Shepody Bay.

The dominant land uses within the watershed are forestry and agriculture. Approximately 98% of the watershed is forested, broken down as follows: 42% small private woodlots, 0.5% is crown land, and 57% industrial freehold forest land owned by J.D. Irving. Only 1% of the watershed has been cleared for agriculture, 21% used to grow row crops or grains, 79% pasture or hay, and 0% blueberries (Department of Natural Resources 2014).

The lower reaches of the Anagance tend to be too warm for brook trout in the summer but are capable of accommodating salmon during their spawning run in the fall (Washburn and Gillis 1994). Historically the Anagance was considered less suitable for salmon than the North River (Huntsman 1941), let alone the Pollett or the Little which were well known as salmon rivers (Dunfield 1991). However, there are records of salmon present in the Anagance wherever suitable substrate and shelter were found (Andrews 1943; Huntsman 1944; Huntsman 1945). Elson (1961) suggested that on the Petitcodiac gaspereau (alewives and blueback herring) spawn largely in the Anagance, due to its considerable areas of still water. MacEachern (1965) specified that these were likely Alewives. Blueback

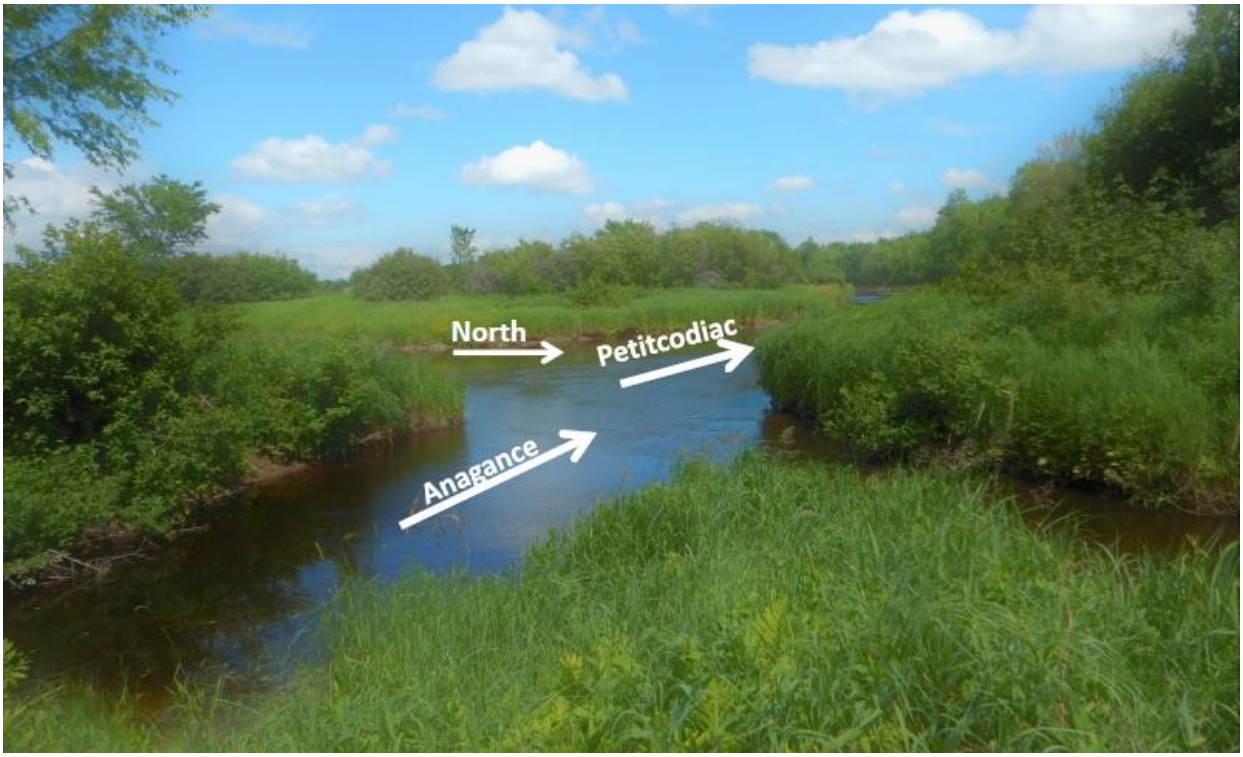

Figure 3: Anagance mouth, looking at confluence with the North, the start of the Petitcodiac.

herring tend spawn a short distance above the head of tide, possibly the gaspereau that Dunsfield (1991) reported spawning near the mouth of the Pollett. Alewives move further upstream than blueback herring, far into fresh water, favoring slow moving parts of rivers or still lakes for spawning (Scott and Scott 1988).

In addition to its main stem, named tributaries of the Anagance River include: Hayward Brook; Holmes Brook; and Harper Brook. While the name Anagance itself might appear obscure, it is quite descriptive, coming from Wolastoqey "Oo-ne-guncé" meaning portage (Ganong 1896). This is a reference to the transportation corridor that this valley provided historically for canoe travel between the Petitcodiac and the lower Saint John River, followed subsequently by a carriage road, the railroad, and even today's highway system between Moncton and Saint John.

First Level Assessment – Land Use History of the Watershed

An understanding of the historical land use in a watershed has the potential to help explain the underlying cause of issues present in a watershed. The following outlines historical land use in the areas surrounding the Anagance River in Westmorland County. Communities in the area surrounding the Anagance River include: Anagance, Anagance Ridge, Dunsinane, Petitcodiac, and Portage Vale (Table 1).

The Maritimes have had human inhabitants for the last 11,000 years (Wicken 2002), though for most of that time precise cultural identities are impossible to determine today. By the early 1600s, when Europeans arrived, much of the native population of coastal Atlantic Canada shared a common culture and language identifying themselves as the L'nuk, "the People", and recognized by Europeans as the Mi'kmaq. During this time, the Mi'kmaq lived in large villages along the coasts from April to November. They grew corn in small garden plots but were mostly dependent upon fish and game for food. Therefore, they tended not to stay in one place for long given the need to follow their food sources so dispersed inland during the winter to hunt moose and caribou (Wicken 2002). Estimates of the pre-contact population vary between 15,000 to 35,000 in what is now Nova Scotia and New Brunswick (Miller 1976, Marble 1993). This declined between 75% to 90% due to social disruption and epidemics brought by Europeans (such as smallpox) during the first century of contact. By 1616, Jesuit priest Pierre Biard estimated the population as 3,500 (Mooney 1928). Physical impacts on the watershed were few compared to what was to follow.

Table 1: Brief historical background summary for communities bordering Anagance River

Community	Settlement Type and Dates	Notes
Anagance *(Anagance River)*	Settled: 1810 Farming and Lumber	**1866** 10 resident families **1871** Station on European and North American Railway **1901** Station on Intercolonial Railway Population 150, Post Office, church, sawmill, 2 stores, includes Joney Settlement and Hayward Settlement **2023** part of Kings Rural District
Anagance Ridge *(Anagance River)*	Settled: Not available Farming	**1866** 8 resident families **1898** Population 75, Post Office includes Lombard, Harper Settlement, and Buckley Settlement **2023** part of Kings Rural District
Dunsinane *(Anagance River)*	Settled: Not available	**1871** Station on European and North American Railway, Population 50 **2023** part of Kings Rural District
Petitcodiac (*Head of Petitcodiac*)	Settled: c. 1786 by Blakeney family Farming and Lumber	**Pre-European** Mi'Kmaq Portage Route **1786:** Arrival of United Empire Loyalists **1836:** Overnight Coach stop on Carriage Route between Saint John and Amherst **1839:** First bridge over the Petitcodiac **1860** European and North American Railway connects Saint John to Moncton **1869** renamed Petitcodiac **1898** population 700, Station on Intercolonial Railway, depot for The Elgin, Petitcodiac, & Havelock Railway, post office, 6 stores, 2 hotels, tannery, sawmill, furniture factory, 4 churches **2023** part of The Community of Three Rivers
Portage Vale *(Kennebecasis River)*	Settled: Not available Farming	**1871** Population 150 **1898** Population 100, hotel **1911** Post Office includes Sussex Portage **2023** part of Kings Rural District

(Source: Provincial Archives of New Brunswick, 2017)

Ganong's (1905) map of known First Nations villages and campsites includes a Mi'kmaq site at Salisbury located along the north bank of main stem of the Petitcodiac, near the head-of-tide between the mouths of Little River and the Pollett River. A native leaving Beaumont (where there was another camp in the lower Petitcodiac estuary) could ride the 13 km per hour tidal bore upstream to Salisbury, greatly facilitating such travel (Petitcodiac Heritage River Committee 2000). The importance of the Salisbury encampment was due to its location both at the head-of-tide and near the ends of a pair of portage routes leading to the Saint John River system. The more highly traveled of the two routes crossed from the

main stem of the Petitcodiac River to the Canaan River (Ganong 1914) near what is now the Village of Petitcodiac, as doing so provided the best access to the upper St. John and on to the St. Lawrence (Petitcodiac Heritage River Committee 2000). The other route crossed from the Anagance River to the Kennebecasis River (and from there to the lower portion of the Saint John River system). The name Anagance comes from Wolastoqey "Oo-ne-guncé" meaning portage (Ganong 1896), presumably a reference to the link through this watershed.

In the 1630's the French began to make a serious effort to colonize Atlantic Canada, beginning to arrive in numbers significant enough to develop an enduring Acadian identity (Laxer 2006), at a fairly similar timeframe to the English colonies further south. By 1676 the first Acadian settlers arrived at Beaubassin, near the current Nova Scotia Visitor's Centre along the Trans-Canada Highway at the New Brunswick border (Larracey 1985). During this time there was much Acadian and Mi'kmaq intermarriage (Marshall 2011) weaving a complex web of family relationships. French authorities encouraged intermarriage to produce a colonial hybrid population, while further south the English tended to aggressively enforce racial segregation (Prins 1996). Meanwhile the Mi'kmaq had begun to adopt Catholicism from the French, while the British were Protestants, at a time when such differences added fuel to conflicts. Acadians also maintained good relations with the Mi'kmaq in part because the lands Acadians occupied either complemented native use, as with fur traders, or were in areas that were marginal to native concerns as in the case of the Acadian farmers on the tidal flats (Mancke 2005).

By 1710, Acadians and Mi'kmaq in peninsular Nova Scotia fell under British control, which was subsequently formalized in 1713 under the treaty of Utrecht. Previous to the treaty, the French had claimed that the borders of Acadia reached all the way to the Kennebec River (well within in what is now Maine). After the treaty however French Authorities claimed that Acadia was just Port Royal (renamed Annapolis Royal by the British after they seized it in 1710) and the peninsula (modern Nova Scotia excluding Cape Breton). Based on that assertion, the French continued to occupy the mainland (now New Brunswick), in addition to the territory they retained officially under the treaty (Martin 1995) i.e.: Île Saint-Jean (Prince Edward Island), and Île Royale (Cape Breton Island). The British were not in a position to contest this reality due to a lack of soldiers and settlers (Ganong 1901). By 1730 the Acadian community in the Petitcodiac was thriving precisely because they were under the jurisdiction of neither Great Brittan nor France (Faragher 2005). That situation did not last, however. With no agreed boundary between English and French territory provided by the Treaty of Utrecht, the French eventually adopted and defended the Missaquash River as the de facto boundary between the two powers (Milner 1911), the same boundary that is in modern use between New Brunswick and Nova Scotia. To Europeans the treaty had merely changed the status of Nova Scotia from a fairly uninhabited French territory with

disputed boundaries, to a fairly uninhabited British territory with disputed boundaries (Martin 1995). It was rather more personal to the Mi'kmaq and Acadians who lived there.

Meanwhile, after 1713, New England fisherman pushed more aggressively into Nova Scotia's coastal waters sparking conflict with the Mi'kmaq (Wicken 2002). By 1726 the Mi'kmaq and the British signed the first of a series of Peace and Friendship treaties. What the British wanted from the agreement was native recognition of the Treaty of Utrecht whereby natives agreed not to molest His Majesty's subjects in "lawfully" made settlements, and the Crown could regulate the movement of European nationals into Acadia – i.e., exclude the French. In exchange the British agreed not to interfere with native hunting, fishing, planting activities.

In June 1749 Edward Cornwallis established Halifax with 2,500 settlers as a new capital for Nova Scotia (Beck 1979) and constructed the citadel there as a fortress to defend it. This marked the beginning of meaningful efforts by the British to settle the Maritimes. Prior to this time British authority at Annapolis Royal "had been no more than a mock government" that "did not extend beyond the cannon reach of the fort" (Philipps 1720). The Mi'kmaq immediately recognized the implications of this change and reacted with outrage to what they regarded as establishment of an unlawful settlement in violation of the Treaty of 1726, and theft of their land. No responsible indigenous leader could ignore the reality that environmental change brought about by such agricultural settlement was the most lethal threat that British imperial expansion posed to the existing economy, livelihood, and health of the Mi'kmaq (Reid 2013). Violence escalated until by late 1749 Governor Cornwallis proclaimed a policy aimed at "extirpation" of the Mi'kmaq (Paul 2000).

The French built Fort Beausejour in 1751 at the border to protect Acadian communities in what is now New Brunswick from attack by the British. By this time the Acadian population near the Fort had grown to 1,541 people, with an estimated additional 1,100 spread out at Shepody and along the Petitcodiac and Memramcook Rivers (Larracey 1985). Their physical impacts on the Anagance River, what for them was a remote hinterland, were limited.

In 1752 the British signed yet another treaty with the Mi'kmaq reaffirming the 1726 treaty and also modifying it to formalize a commercial relationship between the British and the Mi'kmaq (Wicken 2002), encouraging not only hunting and fishing, but ensuring "free liberty" to sell the products of such activities in Halifax or any other settlement. For the British this provision was critical as an attempt to wean the Mi'kmaq from their friendly relationships with the Acadians and French officials in Louisburg. This treaty subsequently formed the basis of the 1999 Supreme Court Marshall decision and subsequent ongoing modern lobster fishery disputes.

Ganong (1899) notes that like First Nations, the French made use of the Kennebecasis-Petitcodiac portage along the Anagance to maintain communication between Fort Beausejour and Acadian settlements on the lower St. John. However, the French route between the Canaan and the Petitcodiac to access the upper St. John was slightly different than the one favoured by First Nations, reportedly crossing overland to the Canaan from the North River, rather than the main stem of the Petitcodiac (Raymond 1891). From there messengers from Fort Beausejour, and the Fortress of Louisbourg passed up along the St John to reach Quebec.

After the fall of Fort Beausejour in 1755, the British attempted to expel the Acadians, to open up land for English settlers. There is a record of an Acadian settlement, Village Victuare, located in Salisbury, close to the Mi'kmaq encampment there (Ganong 1930). It was documented in 1758 by British Major George Scott as he was forcefully removing Acadian families from the upper Petitcodiac (Scott 1758). Ganong (1930) suggests that it is likely that in the wake of the expulsion, Acadians briefly occupied locations such as Fourche-à-crapaud at the mouth of Turtle Creek, and on the Coverdale (Little), and Pollett Rivers in order to be near the head of tide and thus above the reach of English Ships. Major Scott apparently found the tidal bore on the Petitcodiac problematic during his raids in 1758, nearly losing two ships on one occasion (Pincombe and Larracey 1990).

The Mi'kmaq sided with the French (Wicken 2002), participating in the defense of Fort Beausejour, as well as the short guerilla war which followed its capture (Grenier 2008). There were several reasons that Mi'kmaq in New Brunswick did so. In addition to intermarriage, prior to the arrival of the British, native communities had already established trade networks with the Acadians for steel tools, weapons and other European goods (Walls 2010). Another source of friction was that the Mi'kmaq had begun to adopt Catholicism from the French, while the British were Protestants, at a time when such differences added fuel to conflicts. Acadians also had had good relations with the Mi'kmaq in part because the lands Acadians occupied either complemented native use, as with fur traders, or were in areas that were marginal to native concerns as in the case of the Acadian farmers on the tidal flats (Mancke 2005). English settlers on the other hand tended to seize land the Mi'kmaq valued, to clear the forest for agriculture (Francis et al. 2010).

Throughout 1760 and 1761 the British also signed a series of Peace and Friendship treaties with individual native communities, reaffirming the treaties of 1726 and 1752 (Wicken 2002), with the signature at Chignecto/ Missaquash occurring on July 8th, 1761. The important distinction with this iteration of the treaties was the provision by which natives agreed not to trade with the French. To ensure that such trade did not occur the British agreed to establish "truck houses" as points of trade near native communities.

The Treaty of Paris in 1763 ended the Seven Years War, with France ceding its territory in Canada and the Maritime region to Britain, except for the small islands of St. Pierre and Miquelon in the Gulf of St. Lawrence (Ganong 1901; Faragher 2005). The latter France retained in the interest of preserving its access the lucrative fishery in the Gulf of St. Lawrence and the Grand Banks (MacNutt 1970). Shortly thereafter a royal proclamation set the boundary between Canada (Québec) and Nova Scotia as being the watershed between the Saint Lawrence and points south until reaching the north coast of the Bay of Chaleur. All of Nova Scotia north of the Bay of Fundy (modern New Brunswick) was made part of Cumberland County. In 1765 that was changed to make the Saint John River into Sunbury County. There was no formally defined boundary between Sunbury and Cumberland Counties until 1770 when it was set as a somewhat arbitrary line beginning at Mispec (a short distance along the coast east of the mouth of the Saint John River) headed due north to the Canadian (Québec) border (Ganong 1901).

With peace, in 1763, Acadians throughout the region became British subjects, but this was not the case for First Nations, whose situation was more complex (Beaulieu 2014). The British defeat of France at Louisburg in 1758 encouraged the political collapse of the Mi'kmaq population in Nova Scotia as a fighting force as the peace and friendship treaties signed between 1760 and 1761 brought an end to Indigenous-French relations and alliances (Patterson 1993). Between typhus brought by the d'Anvill expedition, violence promoted by LeLoutre, and Cornwallis' policy of Mi'kmaq extirpation, by 1763 First Nations had been decimated by decades of warfare and disease, with some estimates suggesting that there may have been fewer than 500 individuals remaining in the Maritimes (Statistics Canada 2020).

In 1764 the British government began to allow Acadians to resettle in Nova Scotia with the provision that they remain in small groups scattered throughout the province (MacNutt 1963). Initially they were not allowed to settle in groups larger than 10 persons, the goal being to keep them at great distances from each other, or even ultimately discourage them from remaining in the colony at all. Since the authorities did not give those Acadians who remained a fully legal position by making grants of land, their status was little better than squatters (MacNutt 1963). It is an important and sobering reminder that eighteenth-century people understood that military disruptions did not have the long-term permanence that they might want, without civil validation (Mancke 2019). Consequently, the ultimate dispossession of Acadians came not through the barrel of a gun, but through the power of the pen, and less in the heat of war, than in the quiet of peace.

During the American Revolution, control of Fort Cumberland (formerly Fort Beausejour) was briefly contested by rebels in 1776. Though unsuccessful, the participation of Mi'kmaq and Wolastoqiyik in the siege highlighted the vulnerability of Nova Scotia and prompted the Crown to enter into what became the final round of Maritime Peace and Friendship

Treaties with First Nations in 1778 and 1779, reaffirming the previous treaties (Patterson 2009).

The American Revolutionary War ended with yet another Treaty of Paris, this one in 1783 (MacNutt 1963, Ganong 1901). Early in the war the Americans had taken it for granted that winning their independence also implied the acquisition of the two provinces (Nova Scotia and Canada) that had not revolted. In the end however, the agreed terms established rough boundaries between British holdings and the newly recognized United States, that while not yet finalized along the St. Croix River, were distant from the Anagance River. The peace fell short of the hopes and expectations both sides had harbored during the war, but despite the distance from the border, was not without implications for the Anagance. For every Loyalist within British lines, there were five left living within territories dominated by the Continental Congress (MacNutt 1963). To such Loyalists, peace and recognition of the United States meant surrender of themselves and their possessions to those that had been their enemies. Although the Treaty of Paris promised Loyalists a safe return to their pre-war homes, persecution of "Tories" escalated with the rebel victory (Dallison 2003). An attractive and safer alternative became clear. Across the water lay Nova Scotia, a (comparatively) vacant land which remained beneath the British Crown (MacNutt 1963).

As things warmed in the spring of 1783 the movement began, with all parts of the coastline receiving refugees, many of which landed on the north shore of the Bay of Fundy (Squires 2000), of which approximately 11,000 eventually stayed on (Wynn 1981a), tripling the population from a little more than 5,000 to more than 16,000 in less than a year. Almost 10% of the refugees were black loyalists, and 10% of those (i.e., approximately 1% of total Loyalist refugees) arrived in the region as slaves. (Hodges 1996). The main point of penetration was the Saint John River Valley, however, the Petitcodiac, Memramcook, and Chignecto regions each received a share Loyalist refugees as well (Wright 1945, Milner 1967, Bowser 1986).

Even before departure from New York, Loyalists had begun to contemplate a separate and distinct province (Dallison 2003), and support for the concept only grew once they arrived in Nova Scotia. Governor Parr began escheating parts of pre-Revolution grants immediately to provide lands for the newcomers jamming into port towns clamoring for land (Fellows 1971). The need for land was paramount as it meant survival, food, and fuel- as well as status and wealth. Parr's inability to release land quickly enough frustrated Loyalists (Snowdon 1983) and was a key factor driving calls for partition (Gilroy 1933). Edward Winslow, an individual responsible for settling Loyalist Regiments in Nova Scotia became a leading proponent for partition arguing in a letter to his friend Ward Chipman in 1783, "Take the general map of this province (even as it is now bounded) observe how detached this part is from the rest, how vastly extensive it is, notice the rivers, harbours, etc. Consider the numberless inconveniences that must arise from its remoteness from

the metropolis and the difficulty in communication. Think what multitudes have and will come here, and then judge whether it must not from the nature of things immediately become a separate government" (Winslow 1783).

Halifax was opposed to Nova Scotia being subdivided for obvious reasons (Chipman 1784), however the authorities in London agreed (Gilroy 1933). On June 18th, 1784, Nova Scotia was partitioned, and the north shore of the Bay of Fundy became New Brunswick, a self governing "Loyalist" province. Once again, the Missaquash River was selected as the boundary (Allison 1916), with the Anagance River watershed falling within what became Westmorland County (Ganong 1901). Thomas Carleton arrived in November 1784 to establish the new government and direct the colonization of New Brunswick (Fellows 1971). With access to title to land having been a driving factor in its formation, the newly established Province of New Brunswick required that existing land grants be re-registered both to facilitate escheat and to establish clear title for active landowners (Kernaghan 1981), and the House of Assembly focused on allocation of land as one of its initial priorities (Fellows 1971).

The dates that various communities listed in Table 1 were first settled (where available) indicate how movement by English colonists into the upper reaches of the Petitcodiac River above the head of tide occurred first along the more easily accessible main stem. Many of the early dates coincide with the arrival of United Empire loyalists from the 13 colonies (late 1770's - 1780's). After the arrival of the Loyalists, Mi'kmaq in what is now New Brunswick were moved off their lands and onto "reserves" (Walls 2010). This was done partially to provide land to incoming settlers, and partially to punish the Mi'kmaq for aligning themselves with the French.

Subsequent generations of English settler families and those that arrived after them then pushed further up the Petitcodiac and into its more remote tributaries such as the Little River, and the Pollett River (Wright 1945). An early example would be John Colpitts, the eldest son of Robert Colpitts who had settled near Salisbury in 1783. John Colpitts arrived from England as a teenager with his father and had already moved on to develop his own homestead just a few years later, founding Colpitts Settlement on the Little River (Moncton Daily Times, Thursday August 26th, 1920).

Given the technology available to early English settlers, there are two important differences between the Anagance River and both the Little and Pollett. The first is that like the North River, the Anagance flows almost entirely within the Eastern Lowlands Ecoregion (Department of Natural Resources 2007). This sets it apart from both the Little and the Pollett, which travel a relatively steep gradient downstream starting in the Central Uplands Ecoregion, then descending into the Continental Lowlands Ecoregion, and finally ending in

the Eastern Lowlands Ecoregion. Consequently, the soils and climate of the Anagance has more in common with the North River than the Little or the Pollett.

The second difference was accessibility. Its low gently sloping gradient made travel along the Anagance relatively easy compared to the Little or the Pollett. At its mouth near the Village of Petitcodiac, the Anagance River is approximately 25 metres above sea level. Approximately halfway up its length, near the Village of Anagance, the river channel has only risen 10 metres to about 35 metres (Natural Resources Canada 1997). That is the approximate point from which the portage from the Anagance departed the channel to cross over the ridge to the Kennebecasis, putting in near Portage Vale, making it the de facto travel route between the Petitcodiac and lower Saint John watersheds. This same characteristic led to the selection of the Anagance valley for the route of the European and North American Railway in 1860 (Stronach 1969), linking Saint John to Amherst Nova Scotia, via Moncton (and in the process opening up the entire Anagance watershed from its headwaters to its mouth). The railbed crosses the divide between the Anagance and Stone Brook (a tributary of the Kennebecasis) at Dunsinane, approximately 50 metres above sea level, a mere 25 metres higher that at the mouth of the Anagance (Natural Resources Canada 1997). In comparison, the steeper headwaters of both the Pollett and the Little became progressively more remote to early settlers, the further upstream one went.

Forestry Practices

The relative inaccessibility of the Petitcodiac stood in contrast to the Saint John River, as the comparative lack of long easily navigable tributaries within the Petitcodiac system discouraged commercial logging activities until the mid-1800s (Department of Natural Resources 2007). Instead, early settlers cleared the land to allow for agriculture, locally consuming cordwood for fuel, and lumber to build their homesteads, while generating only limited income by selecting marketable timber to send downriver to be sold for shipbuilding or export. As time progressed the latter gradually became a more significant aspect of the local economy. Timber harvest in the Petitcodiac timber district as a whole grew from 260 tons in 1818 to 3,137 tons by 1836 (Wynn 1981b), though this paled in comparison cutting in other more accessible portions of the province such as in numerous timber districts along the Saint John and Miramichi Rivers where harvests taking place at the same time were in some cases an order of magnitude greater.

During the early 1800s white pine was gradually culled from New Brunswick Forests to meet the demand for masts for the Royal Navy (Wynn, 1981b). The White Pines Act of 1722 established the requirement of a royal license to fell white pines with a diameter exceeding 24 inches unless they were privately owned, and in 1729 Parliament reserved all such trees to the government except those already in private hands before 1690 (Purvis 1999). Since New Brunswick came under British control well after that time, this exception did not apply

at all to its forests. During the American Revolution and the Napoleonic Wars from 80 to 90 percent of all masts supplied to the Royal Navy came from Canada, mostly New Brunswick (Williams 1992). The Napoleonic blockade of the Baltic forced England to expand New Brunswick's lumber production twentyfold, transforming an "undeveloped backwater" of 25,000 people to a bustling colony of 190,000 (Gordon 2014). Pines could still be found in 1850, but few of the magnificent trees the region was known for earlier in the century remained. Spruce was more abundant, but the largest had also been cut. Though there were not many extensive cutover tracts, by 1850 the character and composition of the forests in New Brunswick had been drastically modified over the course of just 50 years of harvesting.

The effects of this early economic activity were not limited to just the forests. By 1820 importation of food into New Brunswick was the rule rather than the exception, everything hinged on the timber trade, though there were warning signs of the danger of single source economy (DeMerchant 1983). James Robb, professor of Natural Science at Kings College in Fredericton (now the University of New Brunswick), was appointed Secretary of the Provincial Board of Agriculture when it was established in 1858. He warned that timber harvesting was so lucrative that it distorted development, and that when the market in Europe declined, the farmer neglecting his homestead to work in the woods would be "surprised to find his fences down, his fields grown up with bushes, and both himself and his snug little clearing generally all gone bad". It was not just agriculture that was falling short of its potential. In the years that shipbuilding boomed at St. John and other towns along the coast, even the fishing industry was neglected as men were drawn to the forest to supply wood (DeMerchant 1983).

During the winters, many men within the Anagance worked in the woods- not only cutting their firewood for the coming year, but to earn cash income (Elliot 1970). To take advantage of the culled mixed forests during this time, many milling operations sprung up and some communities that had begun as a farming settlements developed into lumbering communities. The first mill in Petitcodiac was a grist mill in 1820, built by Humphrey Hayward, that would later be followed by a carding mill and sawmill owned by the same man (Burrows 1984). It was built on the Anagance's Hayward Brook and the settlement that grew around the mill, was named Hayward Settlement. The Jacknife Sawmill was in operation by 1833 in Petitcodiac, and a spool manufacturing plant by 1868. Mills were often operated by water, most likely from the river itself or its tributaries. Other milling operations nearby in Petitcodiac included the Petitcodiac Lumber Company on the North River, and the Humphreys and Trites Mill on the mouth of the Anagance and North Rivers.

By 1860 the European and North American Railway linked Saint John and Moncton, running the length of the Anagance valley, through Petitcodiac Village (New Brunswick Railway Museum 2015), at the time known as Humphrey Corner (Village of Petitcodiac 2015). Fuel

for the engines was cordwood in three-to-four-foot lengths purchased from farmers along the line (Stronach 1969), the portion in the Anagance valley came from hardwoods growing to either side of the rail line (Elliot 1970). Farmers received “tokens” (redeemable for cash) for wood used by the railway company from piles placed along the track at designated locations. Petitcodiac Village itself served as a hardwood fueling station, and a lumber shipping station that would have rivaled larger cities of the time (Burrows 1984).

At that point the age of wooden ships was beginning to wind down however, causing a reduction in the scale of the demand for timber exports both as wood and manufactured into ships. By the end of the Crimean war in 1856, virtually all of the ships in the British Royal Navy were already fitted with steam engines rendering masts irrelevant (Evans 2004), and the conversion to iron hulls began within a decade thereafter.

A non-timber forest product on the Anagance, was tan bark (Elliot 1970). Hemlock trees were cut down, and the bark was stripped off and hauled to the tannery in Petitcodiac. Because the logs would not float, they were often instead put on brooks to make bridges or corduroy roads. Elliot (1970) also notes that maple trees were tapped for sap, with farmers producing syrup, sugar, and candy- though such opportunities were somewhat scattered. The low elevation and poor drainage of much of the watershed suggests that this was likely more often possible along the ridges (Continental Lowlands Ecoregion), than the valley bottom (Eastern Lowlands Ecoregion), as sugar maple prefers well drained soils (Ritchie 1996).

Agricultural Practices

In the early 1800s most New Brunswick families were working the soil and tending to domestic livestock on forested acreages acquired by government issued grants that gave them freehold title to their lands (Parker 2015). Settlers near Anagance Ridge received land grants in 1803 with the commitment to clear and cultivate 3 acres out of every 50, or if the land was swampy and marshy, to drain and clear 3 out of every 50, and for every 50 acres of barren land, to keep 3 three cattle (Elliot 1970). However, there was an element of land speculation in the process as one of the largest Anagance grants was 1000 acres in 1834 to The Honorable Ward Chipman, a justice of pre-Confederation New Brunswick’s Supreme Court. That was approximately 3% of the entire watershed, and clearly, given the nature of Chipman’s work, more of an investment than personal homestead- sold in 1850 by his wife (after his death) to John Simonds, another non-resident elite, the son of the Province’s Treasurer. Simonds divided the land and progressively sold off portions to homesteaders over the following 15 years. Most of the land at that time was forest, which settlers cut and burned to clear, spreading ashes as fertilizer (Elliot 1970). Tree stumps were left to rot, with crops sown amongst them (DeMerchant 1983).

Early English settlers, like the Blakeneys who settled the Village of Petitcodiac in 1786, would have cleared the land and planted gardens that they may have later expanded to crop fields (Burrows 1984). In Perley's (1857) Handbook of Information for Emigrants to New Brunswick, he suggests that "No emigrant should undertake to clear land and make a farm, unless he has the means of supporting his family for 12 months." However, it was not just a matter of the financial resources of individuals. Since in the early 1800's the province as a whole was not self-sufficient agriculturally, it is unlikely the communities along the Anagance River were either. However, given the logistical challenges of transporting food to remote homesteads, it is doubtful that importation of food was as practical along the Anagance as in urban centres.

More likely for the early settlers, subsistence agriculture was supplemented with food available from the forest and river. The surrounding area, especially the New Canaan District, was famous for its moose hunting (Burrows 1984). There are historic records of salmon in the Anagance River, and extensive fishing dating back to early settlement (Dunfield 1991). Salmon were taken by spear fishing in the freshwater portions of the river compared to the seins and weirs used in the estuary. The intensity was such that as early as 1826 the Provincial Legislature passed an act to protect salmon on the Petitcodiac, limiting fishing to 3 days a week, and closing it after August 20th. By the 1840's there were suggestions that nothing short of complete closure of the spear fishery would prevent extirpation of salmon from the Petitcodiac. Freshwater reaches of the river such as the Anagance were closed to salmon fishing in 1869 for conservation reasons, but they were "constantly and severely poached" (Dunfield 1991)

As late as 1876 fishing regulators noted that farmers devoted a significant portion of their time to fishing salmon, with most of the entire catch being used for home consumption (Commissioner of Fisheries 1877). This pattern had been established a generation previously downstream along on the main stem of the Petitcodiac. In 1783 while Robert Colpitts first crop at his farm near Salisbury was ripening, his family's main source of food was salmon (Moncton Daily Times, Thursday August 26th, 1920).

Most early roads, such as those that were present when Chipman received his grant in 1834, were little more than foot trails (Elliot 1970). An exception was the Westmorland Great Road (Route 106 today). It was built by the 1830s - graveled and smooth enough to run a stagecoach at a full trot when the weather was fine (Goodrich 2010). It connected Saint John and "The Bend" (Moncton) via something resembling the Anagance valley portage route, and this route had been already surveyed and well-traveled on foot and by horseback as early as the 1790s. By 1836 the Saint John Stagecoach Company began operating a weekly service between Saint John and Amherst that could make the trip in two days, staying overnight in Petitcodiac (Goodrich 2010), speed that was testament to the relative quality of the road for the time. The arrival of the railway in 1860 (Stronach 1969),

combined with the road network evident in the 1878 Atlas (Dawson 2005), suggests that access throughout the Anagance (a natural transportation corridor) improved rapidly compared to many other portions of the Petitcodiac Watershed. This network was quite similar in coverage (though obviously not quality) to modern roads in roughly the same locations as today.

No doubt the arrival of the European and North American Railway in 1860 (Stronach 1969) ended many of the logistical constraints both on bringing supplies into the Anagance River watershed, and just as importantly, moving marketable surpluses out to trade. It ran the length of the valley, with stations at Dunsinane, Anagance, and the village of Petitcodiac (Provincial Archives of New Brunswick 2017). This had substantial benefits going forward both for settlement and agriculture. The train made it possible to travel from Moncton to Saint John in about 6 hours (New Brunswick Railway Museum 2015). The railway stations within the Anagance valley, being not quite midway, would have been just a few hours travel away from either end. The connection to Saint John provided rapid year-round access to an ice-free port from which most of New Brunswick's exports were shipped overseas. In 1869, two years after Confederation, the line became part of the Intercolonial Railway system, which by 1876 (through Moncton) provided access from Halifax all the way to Upper Canada (New Brunswick Railway Museum 2015).

By 1876, the construction of The Elgin, Petitcodiac, & Havelock Railway branch line, turned the station at the Village of Petitcodiac into a local rail hub. Marketable surpluses of food were being produced nearby on the Pollett River with reports of potatoes being sent by rail as far away as Boston in 1887 (Moncton Daily Times, Monday October 1887), and cattle to Saint John the following year (The Maple Leaf, Albert NB, Thursday October 18th, 1888). In each case, after leaving the Pollett, such cargo would have traveled southwest along the rail line through the Anagance to on its way to Saint John, and beyond.

In early years, milk was produced mostly for home consumption (Elliot 1970). Dairy products were among those perishable products whose production and transport to market was made possible by the expanding road network and rail service. By 1891 a cheese factory was established just outside the watershed nearby at Corn Hill (New Brunswick Department of Agriculture 1892). Shortly thereafter, Anagance farmers were among those supplying the Corn Hill Cheese and Butter Company with raw products (Elliot 1970). Crops reported being raised in the area by 1890 included: hay; grains (wheat, buckwheat, oats, and barley); vegetables (potatoes, carrots, and turnips); and fruits (apples, and plums) (New Brunswick House of Assembly 1890). Livestock included: cattle (Ayrshires, Jerseys, and short horns); sheep (Shropshire Downs); pigs (Yorkshires and Berkshires), as well as turkeys, geese, chickens, and bees (Elliot 1970).

Mining Practices

Salt springs were discovered early in the settlement of the area (Norman 1932). Johnston (1851) notes that while crossing overland from Moncton to Saint John along the road already present through the Anagance valley, he briefly diverted north at the Village of Petitcodiac to examine limestone and salt springs on the North River, a short distance from the mouth of the Anagance. That potential was eventually realized. The Geological Survey of Canada (1890) concluded that, "gypsiferous beds in the vicinity of the salt springs along Salt Springs Brook and in the North River valley near Petitcodiac enrich the soil in these particular localities." The Petitcodiac Mining and Manufacturing Company (1860-1909) developed the lime resources of the Glenvale district along North River's Salt Springs Brook (Burrows 1984). Years later Goudge (1934) noted the remains of the quarry just south of Glenvale, that had supplied local farmers with raw agricultural lime. Similarly, between 1850 and 1900, near the Anagance headwaters, a short distance over the divide down the Kennebecasis side at Plumsweep, brine from salt springs was being collected and evaporated to extract salt needed by the dairy industry in Sussex, perhaps eventually also supplying the cheese factory at Cornhill (Norman 1932, Hamilton 1961). Though underlain by the same deposits (the Anagance Axis Salt Area (Hamilton 1961)) feeding those sites, there is no record or evidence of historical extraction of either sort within the Anagance watershed itself, perhaps due in part to local demand being met by access to supply from these nearby operations (particularly given the rail transport available).

Indian Affairs

As laid out in previous sections, the Mi'kmaq and the Crown entered into a series of Peace and Friendship treaties between 1726, and 1779 (Nova Scotia Archives 2020), which form the basis of treaty rights held by the Mi'kmaq today. These were not treaties that surrendered land, but negotiations between sovereign entities. The Mi'kmaq never surrendered title to Mi'kma'ki (Mi'gmawe'l Tplu'taqnn 2023). Treaty rights and aboriginal rights are recognized and affirmed in Section 35 of the Constitution Act 1982 (Sanderson 2017). These treaties were briefly described in previous sections within the chronological context that gave rise to it, to track the evolution of the treaties. However, as these treaties are still in effect and still relevant in New Brunswick from that time up to today, there is also value in compiling these within a single section to provide focus, make them more easily accessible, and by doing so make them more easily understood in their entirety. The five treaties are listed and identified in Table 2.

In several cases a given treaty has more than one year attached to it. That is because of the complexity of negotiations, the large number of signatory communities, and the distances between venues at a time when mobility and communications were challenging meant that in several cases the signing process began on one year and was not completed until the following year.

Table 2: Peace and Friendship Treaties between the Mi'kmaq and the Crown

Year	British Objective	Mi'kmaq Objective
1726	Mi'kmaq Recognition of 1713 Utrecht Treaty, "Lawful" British Settlements to be left undisturbed. British right to regulate Europeans	British Recognition of the legitimacy of Mi'kmaq Hunting, Fishing, and Planting activities
Comment:	When signed, the application of this treaty was within British controlled territory. The British interpretation of the 1713 treaty of Utrecht between them and France was that it gave them claim to all of Acadia including the north shore of the Bay of Fundy (modern New Brunswick), but effectively British authority did not go outside of peninsular Nova Scotia. Arguably it "did not extend beyond the cannon reach of the fort" at Annapolis Royal.	
1749	Reaffirm 1726, to end King George's War addressing Mi'kmaq cooperation with the Duc d'Anville expedition, and antipathy to British expansion beyond Annapolis Royal i.e. founding of Halifax. From British perspective did not modify 1726 in any way.	Reaffirm 1726 - British recognition of hunting and fishing
Comment:	Nothing new was offered in the treaty, just reaffirmation of the 1726 treaty. The context however was that it demanded acceptance of the fact the British were becoming more assertive than they had been previously. Among the Mi'kmaq, only the community at Chignecto signed - others refused to do so because British founding of Halifax a few months earlier was considered to be a violation of 1726.	
1752	Reaffirm 1726, to calm the effects of Father LeLoutre's War. Formalized commercial relationship between British and Mi'kmaq to wean Mi'kmaq from relationships with Acadians and French officials in Louisburg.	Reaffirm 1726 - British recognition of hunting and fishing rights and ensured the "free liberty" to sell the products of these activities in Halifax or any other settlement.
Comment:	By this point the French were actively defending the Missaquash River as the border with British territory in Father LeLoutre's War. Mi'kmaq in the Petitcodiac watershed were "on the front line", while those in peninsular Nova Scotia were "behind the lines", living amongst expanding British settlements. This treaty forms the basis of the Supreme Court of Canada 1999 Marshall Decision affirming the treaty rights of First Nations people all across Canada to hunt and fish and earn a moderate livelihood while doing so (Supreme Court of Canada 1999). Resistance to this ruling by non-native lobster fishermen prompted the Burnt Church Crisis between 1999 and 2002 (Wicken 2002). Recently tensions have flared up over lobster in Saint Mary's Bay	
1760/61	Reaffirm 1726 after defeat of the French in North America. This ended Indigenous-French relations and alliances and required natives to end trade with the French.	Reaffirm 1726 - British recognition of hunting and fishing rights, and with the end of French alliances and trade the British pledged to establish "truck houses" near native communities to provide alternative trade now that trade with the French was prohibited.
Comment:	This marked the end direct relations between the French Government and Native communities in the Maritimes. That was finalized in 1763 with the Treaty of Paris which ended the Seven Years War in which France ceded its territory in Canada and the Maritime region to Britain, except for the small islands of St. Pierre and Miquelon in the Gulf of St. Lawrence, which France retained to preserve access to fisheries there.	
1778/1779	Reaffirm 1726 within the new context of British North America being fractured by the American Revolution	Reaffirm 1726 - British recognition of hunting and fishing rights and maintain peace going forward to avoid being drawn into violence between the British and American revolutionaries.
Comment:	While the French were no longer a concern, the participation of Mi'kmaq and Wolastoqiyik (albeit only a few) in Eddy's siege of Fort Cumberland in 1776, and Allan's expedition into the Saint John Valley in 1777 highlighted the vulnerability the Maritimes to attempts by US agents to stir rebellion against the British.	

After the arrival of the Loyalists in 1783, Mi'kmaq in New Brunswick were gradually moved onto "reserves" (Walls 2010), to provide land to incoming settlers. This was made possible in part by a legal technicality. The Treaty of Paris in 1763 ended the French presence in the Maritimes, and the subsequent Royal Proclamation of 1763 recognized the property rights of the native peoples in the recently won portions of North America, but it had never been construed as applying to New Brunswick, which had been part of Nova Scotia at that time (Upton 1974). Safeguards concerning Indian lands and indebtedness, however questionable their ultimate value elsewhere, did not even exist in New Brunswick. Initially there had been little practical need for a policy as Mi'kmaq were few in number, and so scattered that they were not considered a threat to incoming settlers. With the arrival of the Loyalists, "the Indians were driven back into the wilderness without much ceremony".

The first real expression of concern amongst the government arose during the lead up to the War of 1812 (Upton 1974) that discontent might become a problem if war with the United States created an opportunity for trouble. Despite the fact some lands had been allocated to native people, they still maintained their nomadic way of life; and the colonial government's refusal to do anything further for them led to a complaint of "an injurious distinction between them and the Indians of Canada on one side and those within the limits of the neighboring American States on the other." The first listing of reserved lands was not published until 1838 and it identified 15 reserves in the province ranging from 10 up to 16,000 acres. About 60,000 total acres had been designated as Indian reserves in the early 1800s, but none were in Westmorland County (Goodrich 2020).

That changed in 1840 when the Provincial Government purchased 63 acres at Beaumont near Fort Folly Point (Goodrich 2020) at the head of Shepody Bay. The province then conveyed this land to the Magistrates of Westmorland County in Dorchester to hold in trust as a reserve. Then 126 Mi'kmaq moved there from various places within Westmorland County that they had been living to form the Fort Folly Reserve (Perley 1841, Ganong 1899). The land was not turned over to the Mi'kmaq themselves but vested in the county to be held for their exclusive use.

Second Level Assessment – Current Impacts

Forestry Practices

Forest tenure within the Anagance River watershed today is a mixture of private woodlots, industrial freehold, and crown land, which are subject to varying levels of management in terms of harvesting planting and thinning (Department of Natural Resources in 2014). The watershed (Figure 4) covers 138.87 km^2, of which private woodlots are: 58.42 km^2 (42.31%), Crown forests: 0.81 km^2 (0.59%), Industrial freehold leases: 79.64 km^2 (57.69%). Considering that 99% of the Anagance is forested, that translates to 57.35% of the basin being industrial freehold (J.D. Irving), the greatest proportion of any tributary in industrial hands. Industrial freehold in other tributaries rank in descending order as follows: Pollett 25.84%; North 12.77%; Demoiselle Creek 9.63%; Little 0.93%.

Hayward Brook and Holmes Brook drain much of the Industrial Freehold south of Highway 1 in the eastern portion of the watershed. These have been the focus of numerous studies by Environment Canada and J.D. Irving in collaboration with the Fundy Model Forest, L'Université de Moncton, and the University of New Brunswick to gauge the effects of forestry on aquatic ecosystems (Chaisson 1996; Pugh 1999; Pomeroy 2002)

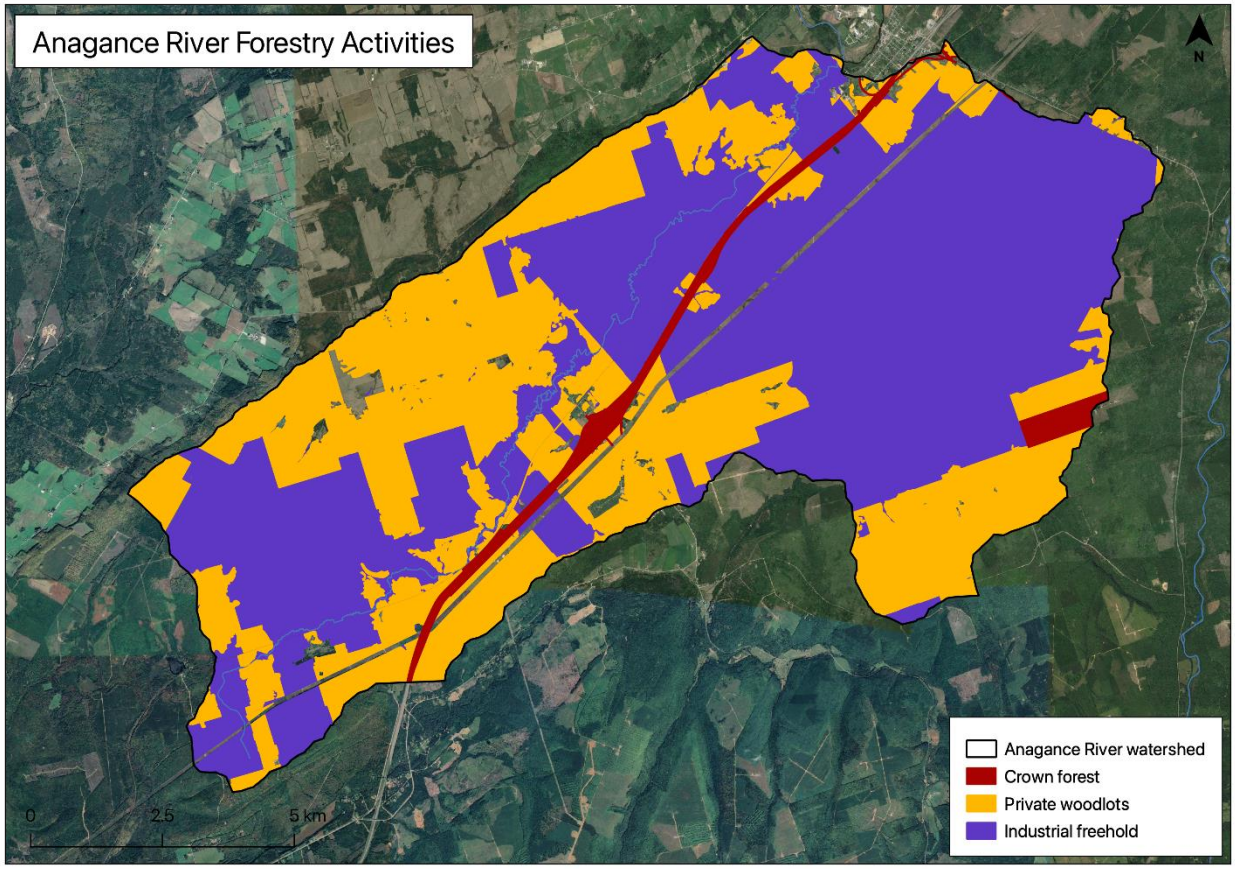

Figure 4: Forest tenure in the Anagance River watershed.

Agricultural Practices

Today the Anagance watershed is sparsely populated with little agricultural development. Though minor (1% of the watershed), agriculture is the dominant non-forest land use within the Anagance River watershed (Department of Natural Resources in 2014). Of the 1.59 km^2 of land being used agriculturally today, pastures account for 1.25 km^2 (79%) of it; and grains were the remaining 0.33 km^2 (21%). These are located either near settled areas such as the Village of Petitcodiac, Anagance, or near the ridge dividing between the Anagance and Jordan Brook (Kennebecasis). There are no cultivated blueberry fields within the watershed, which is somewhat unusual given how common these are within other Petitcodiac tributaries.

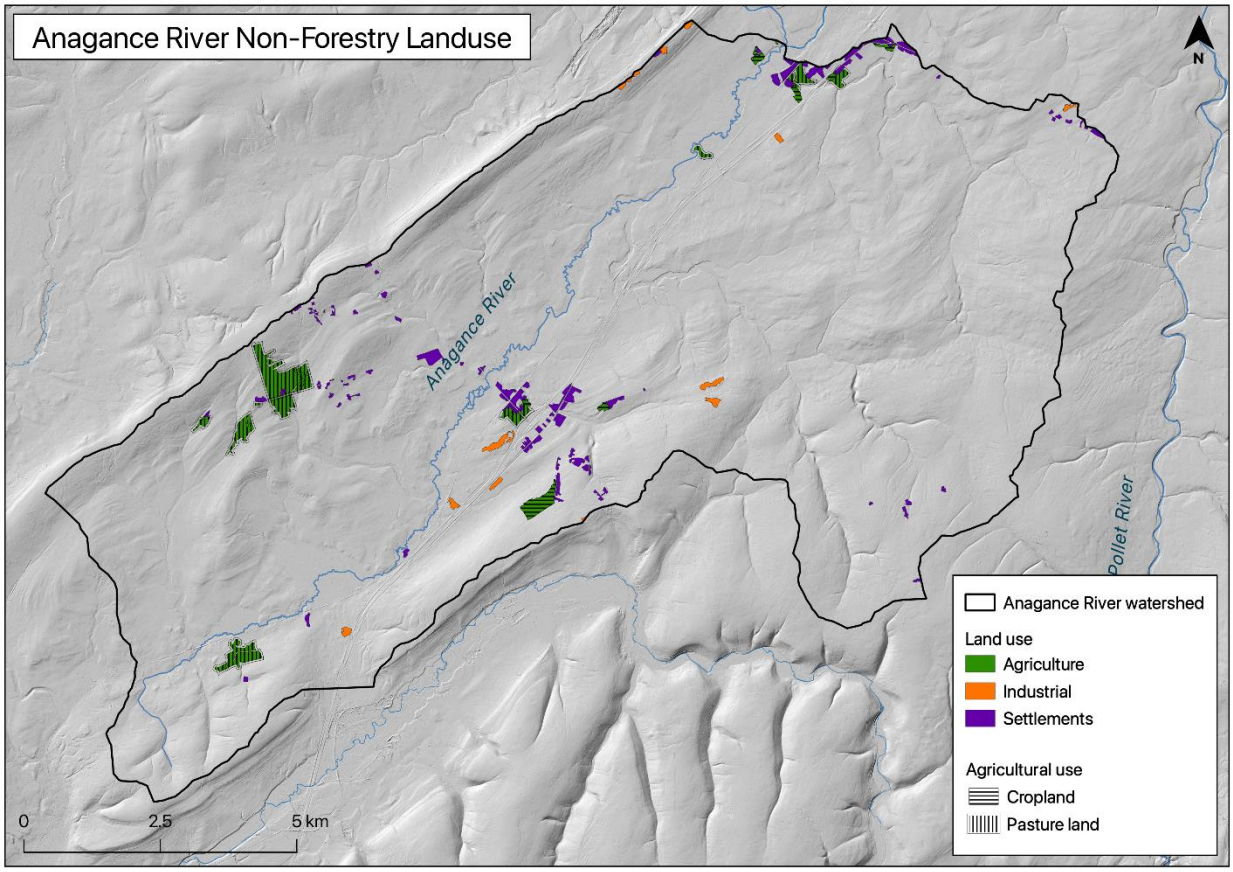

Figure 5: Anagance Non- Forest Land Use – Agriculture

Transportation Development

A GIS layer of the road network (paved and unpaved) within the Anagance River and its tributaries was overlaid to yield Figure 5. This analysis indicated a total of 69 locations where roads crossed the river or tributary streams. Of this 26 were defined as paved, and 43 were defined as unpaved. Being 38% paved is less than nearby on the main stem. That is not surprising however, as the main stem of the Petitcodiac is more populated and developed than its various tributaries, and so a higher proportion of paved roads there is to be expected. For comparison's sake, comparable figures for other watersheds for which FFHR has developed stewardship plans ranked according to proportion of paved crossings are as follows: main stem 69% paved; Little River 54% paved, Demoiselle River 40% paved; and Pollett River 31% paved. The number of crossings appears not unreasonable for the small area involved (138.9 km^2). For comparison's sake the total number of crossings within the 115.2 km^2 of the main stem is 95, a 38% increase – over a slightly smaller area, speaking to the fact that the main stem is more populated and developed.

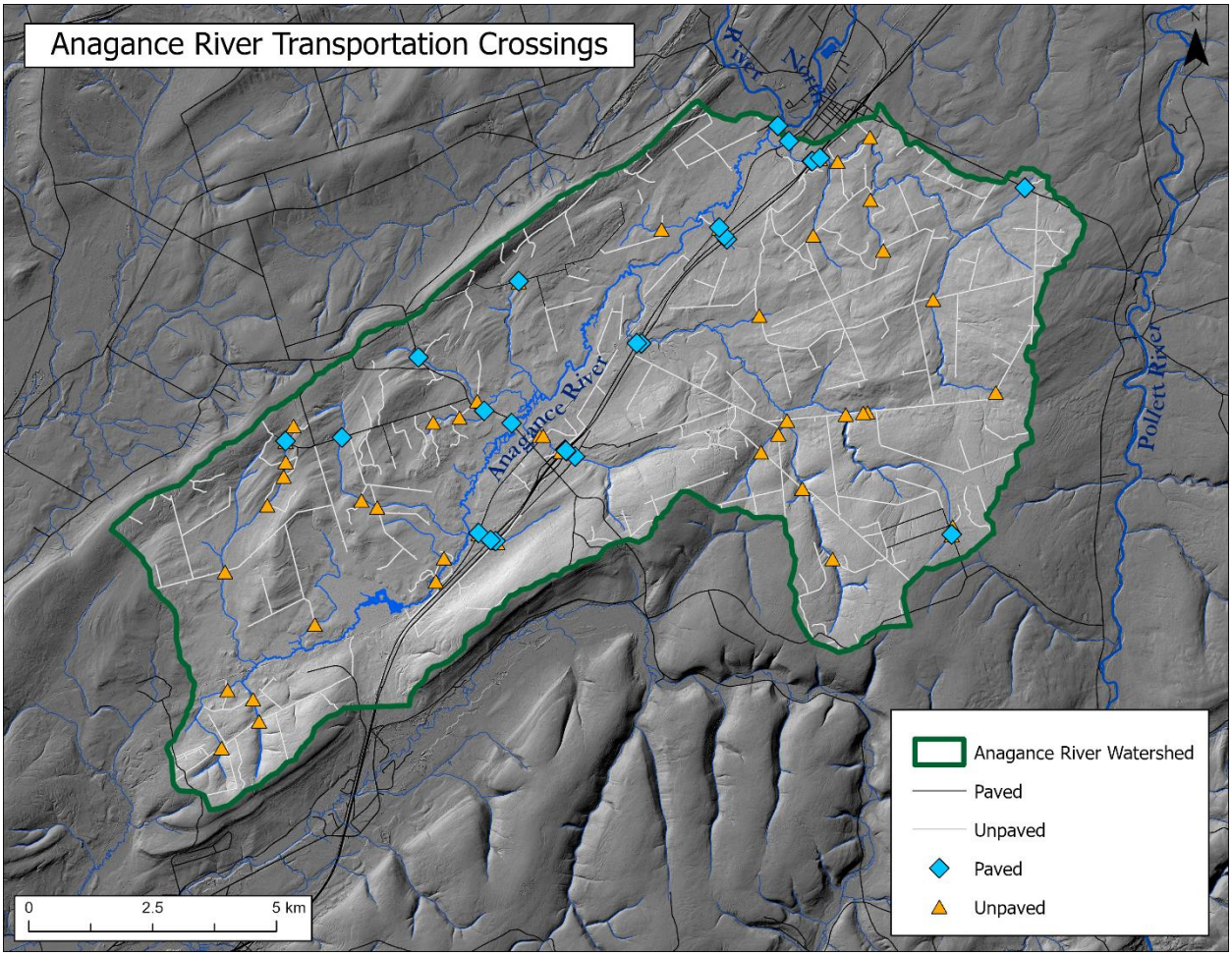

Figure 6: GIS analysis of road / water crossings in the Anagance River.

A thorough inventory of the condition of all of these crossings is needed to examine the extent to which these may be limiting fish passage. Systematic collection of such data will also provide an opportunity to test the GIS analysis, and determine how many crossings that it has missed, and where they are. While several crossings within Anagance River are known to be bridges, the majority are likely to be culverts of varying size and condition. The Petitcodiac Watershed Alliance has carried out a series of culvert surveys throughout the Petitcodiac watershed as part of their Broken Brooks project. Annual reports detailing that work are available for download on the publications section of their website https://www.petitcodiacwatershed.org/ .These reports indicate 10 crossings assessed within the North River to date (Figure 7): 6 bridges, 1 culvert that was a full barrier to fish passage, 2 culverts that were partial barriers to fish passage, 2 culverts that were passable, (Petitcodiac Watershed Alliance 2017). Comparison of these 11 crossings that PWA have assessed to the 69 identified through this GIS analysis indicates that at least 58 water crossings within Anagance River watershed remain to be assessed- probably even more as several of the bridges (presumably ATV Bridges) were not among the crossings identified by GIS. There are numerous ATV bridges in the headwaters (cover, top photo).

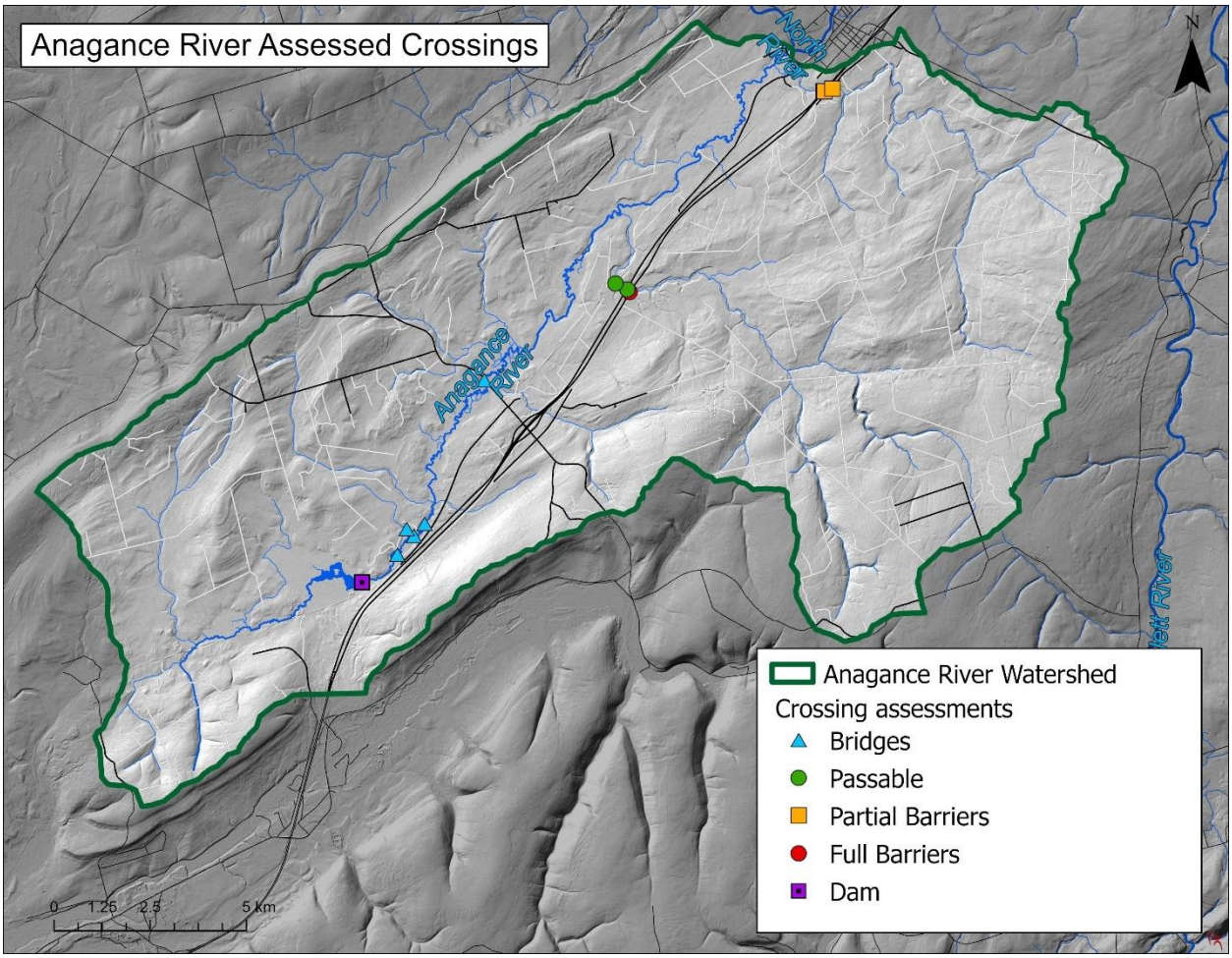

Figure 7: Water crossings visited and assessed by the Petitcodiac Watershed Alliance

Several of crossings that they examined were identified as problem culverts creating barriers to fish passage into useful habitat, potentially benefiting from remediation such as clearing of brush blockages or construction of rock weirs raise water levels in the case of perched culverts (Petitcodiac Watershed Alliance 2017).

While the New Brunswick Department of Transportation (DoT) is responsible for bridges and culverts on the public paved roads, they are not responsible for the vast majority of culverts on unpaved roads which are likely to be on either private woodlots, industrial freehold, or crown land. If a problem culvert is identified and there is a question of who is responsible (private landowner versus DoT), using GPS coordinates responsibility will be confirmed through further discussions with the Department of Transportation.

In 1968, 44 kilometers downstream in the estuary, the Petitcodiac Causeway was built instead of a bridge, in order to accommodate vehicular traffic between Moncton and Riverview. The fishway built into it proved to be ineffective. The causeway gates created a barrier to fish passage with significant consequences for native fish species in the river and led to the decline in the populations of species such as alewife, blueback herring, rainbow smelt, and sea-run brook trout. Some species disappeared altogether from the upland reaches of the Petitcodiac (such as the Anagance), including American shad (Locke, et al. 2003). Atlantic salmon only remained present in the river as a consequence of ongoing stocking efforts (AMEC 2005)

In April 2010 the gates of the causeway control structure were opened as part of the Petitcodiac River restoration project. On May 25th, 2021, the new channel was opened underneath the bridge built to partially replace the Petitcodiac Causeway. October 5th, 2023, this bridge was named in honor of the late senator and MLA Brenda Robertson (Government of New Brunswick 2023a). Fourteen years of monitoring from 2010 to 2023 following the restoration of fish passage (Redfield 2024) found American shad, striped bass, and Atlantic tomcod returning to the river. Of these, the latter two have shown sustained and progressive increases in numbers over the years, while invasive non-native smallmouth bass have declined. Consequently, it is clear from these results that the fish community of the Petitcodiac has the capacity to recover, given the right conditions, and appears to be on its way to doing so.

Herbicide and Pesticide Use

Based on general information provided by Service New Brunswick, two forestry operators (JD Irving as Forest Patrol and Natural Resources) may have conducted work within the Anagance River. While intended blocks of land to be treated were identified by operators that does not necessarily mean that they were treated with herbicides. Products used in these industries may contain the active ingredient glyphosate. Glyphosate is found in several formulations under the trade names Arsenal (PCP 23713), Forza (PCP 26401),

Vantage (PCP 26884), Vision (PCP 19899) and Vision Max (PCP 27736). The active ingredient triclopyr has also been used in the past as Release (PCP 22093).

In addition, two industrial operators (Asplundh and NB Power Transmission) may have conducted work with respect to an industrial right-of-way perspective (rail, transmission lines, etc.). These companies may have used triclopyr as Garlon 4 (PCP 21053), Karmax (PCP 21252) and any of the aforementioned glyphosate products.

Private growers must be individually certified (hold a valid pesticide applicator certificate) but do not report their usage. Likewise, vendors must report total sales but do not provide a breakdown relevant to individual purchasers. It is difficult to find information about individual grower or vendor pesticide or herbicide use.

Mining Practices

Oil and Natural Gas lease rights within the Anagance River watershed are currently registered to Headwater Exploration Inc (Government of New Brunswick 2024). Headwater Exploration is a Canadian company that operates in Alberta and New Brunswick. In 2013 seismic testing in New Brunswick by SWN Resources Inc. on Mi'kmaq traditional lands north of Moncton was halted following protests that became violent and attracted national media attention. SWN is a wholly owned subsidiary of Southwestern Energy Company in the US (SWN 2015). On March 17th, 2015, SWN received an extension on its licenses which were due to expire (Canadian Broadcasting Corporation 2015). The former Liberal Provincial government enacted a moratorium on fracking operations (Canadian Broadcasting Corporation 2014), however the new Conservative Government led by Blaine Higgs has announced its intention to put an end to the moratorium and renew fracking in New Brunswick (Canadian Broadcasting Corporation 2018). If wells are eventually drilled in the Anagance River watershed, impacts will include freshwater extraction from streams, habitat destruction and sedimentation during road building, and the potential for wastewater spills contaminating surface waters.

Fort Folly First Nation

Mi'kmaq never surrendered title to Mi'kma'ki (Mi'gmawe'l Tplu'taqnn 2023), however have limited contemporary presence in the Anagance River watershed (despite it being their traditional territory). There are relatively few Mi'kmaq, and government policies concentrated these downstream on the Fort Folly reserve at Beaumont (in Shepody Bay), at the mouth of the Petitcodiac. Economic decline of the building stone quarries at Fort Folly Point in the 1890s, profoundly affected the reserve. Many families moved to Shediac or land the band held in Richibucto, while others went to Dorchester and the surrounding area. By 1913 only three or four families remained at Beaumont, the last of which left in

1955. In 1958, Beaumont was no longer occupied, title was lost, which has subsequently been challenged in a land claim (Fort Folly First Nation 2021).

Mi'kmaq continued to be part of the community in and around Dorchester throughout the 1950s and 1960s after Beaumont ceased to be a reserve (Goodrich 2020), living as individual families with "status" but without a reserve. That changed in 1969 when the current Fort Folly First Nation Reserve was established near Dorchester at Palmer's Pond on Rte. 106. It was initially named Palmer's Pond Reserve (Fort Folly First Nation 2021), but the decision was soon made to rename it the Fort Folly Indian Reserve. The present band, which is mostly descended from those who had occupied Beaumont (Kristmason 2004), does not consider this to be a new foundation, but continuity, with a relocation from Beaumont (Goodrich 2020). Fort Folly, which had been the name of the original reserve at Beaumont, was named geographically for the location on which it existed (Perley 1841, Ganong 1899). Today the band has thirty-six members living on reserve, and a further ninety-six living off reserve.

Urban Development

The Anagance River watershed is sparsely populated with little agricultural development. Approximately 98% of the Anagance is forested, with 57.35% of the basin being industrial freehold belonging to J.D. Irving Ltd., and only about 2% is in agriculture or settlement. In comparison for the two adjacent watersheds the combined proportions for such other uses are as follows: North River 32%; and the Pollett River 6% (Department of Natural Resources in 2014).

There has been limited population growth in the Anagance compared to other portions of the Petitcodiac. Much of the watershed lies within Cardwell Parish, though the boundaries of the two are not an exact match. The 2016 census reported 1,353 people in Cardwell Parish (Statistics Canada 2017) spread across 311.9 km^2, a density of about 4.3 people per km2. By comparison, tallying up the population centres in 1871, there were approximately 650 people (Provincial Archives of New Brunswick 2017), a density of perhaps 2.1 people per km^2, suggesting that the population of Cardwell Parish may have roughly doubled over the last 150 or so years. Its immediate neighbor, Salisbury Parish (once the Villages of Petitcodiac, and Salisbury are included) is almost twice as densely populated today (7.8 people per km^2). While this is less than the average population density in New Brunswick in 2016 of 10.5 persons per km^2 (Statistics Canada 2017), both parishes have developed beyond the province's average population density of 3.9 persons per km^2 in 1871.

This difference in population density between the Anagance and other Petitcodiac tributaries is significant because, addition to clearing for agriculture, large areas of privately owned land on the North, Pollett and Little River watersheds have been developed into homes, or cottages, leaving little or no buffer in the riparian zone to provide residents

with clear views of the river (Petitcodiac Watershed Alliance 2010). Such properties are also a potential source of sewage contamination as rural septic systems are not always properly maintained. Several sites were noted where homeowners had pipes discharging directly into the river. With few private dwellings scattered throughout the watershed these impacts are less common on the Anagance (Petitcodiac Watershed Alliance 2016). That said however, the watershed is far from pristine, as infringements on riparian buffers caused by forestry (recent clear cuts), the rail corridor, and transmission lines are common (Pugh 1999).

The greatest degree of development is near the mouth of the river and along Hayward Brook within what was the Village of Petitcodiac. The river's headwaters meanwhile begin about 30 km west near Dunsinane. Local Governance Reform by the Province (Government of New Brunswick 2023b) amalgamated governance to divide the Anagance River watershed between The Community of Three Rivers at its mouth and Kings Rural District in its headwaters. The line between the two falls about hallway up its length, a short distance downstream of the Anagance Ridge Road Bridge over the main stem of the river.

Third Level Assessment – Aquatic and Riparian Habitat Assessment

Wildlife

Several species of wildlife that warrant specific attention either are or have been historically found within the North River watershed: Atlantic salmon, American eels, and wood turtles. Guidelines for projects in areas with these are in the Appendix.

Atlantic salmon (*Salmo salar*) Inner Bay of Fundy (iBoF) populations were listed as endangered under the Species at Risk Act in 2003 (DFO 2010; SARA Registry 2013a), and the species is considered extirpated from the Petitcodiac River system, except for those introduced in stocking programs (AMEC 2005). The decline in iBoF salmon is a marked contrast to the abundance described by early settlers (Dunfield 1991). Though numbers had been decreasing for some time (Elson 1962) construction of the causeway between Moncton and Riverview in 1968 complicated fish passage and extirpated the species from a river system that despite being 1 of 50 iBoF rivers, represented 20% of the total iBoF population (Locke, et al. 2003).

American eels (*Anguilla rostrata*) were designated as "Special Concern" by COSEWIC in 2006 (COSEWIC 2006). Their status was re-examined and raised to "Threatened" in May 2012 (COSEWIC 2014). This species is being considered for listing under the federal Species at Risk Act, but currently it has no status (SARA Registry 2013b).

Wood turtles (*Glyptemys insculpta*) were designated as "Special Concern" by COSEWIC in 1996 which was raised to "Threatened" in 2007 (COSEWIC 2007; COSEWIC 2011). This species is listed as "threatened" under the Species at Risk Act (SARA Registry 2012).

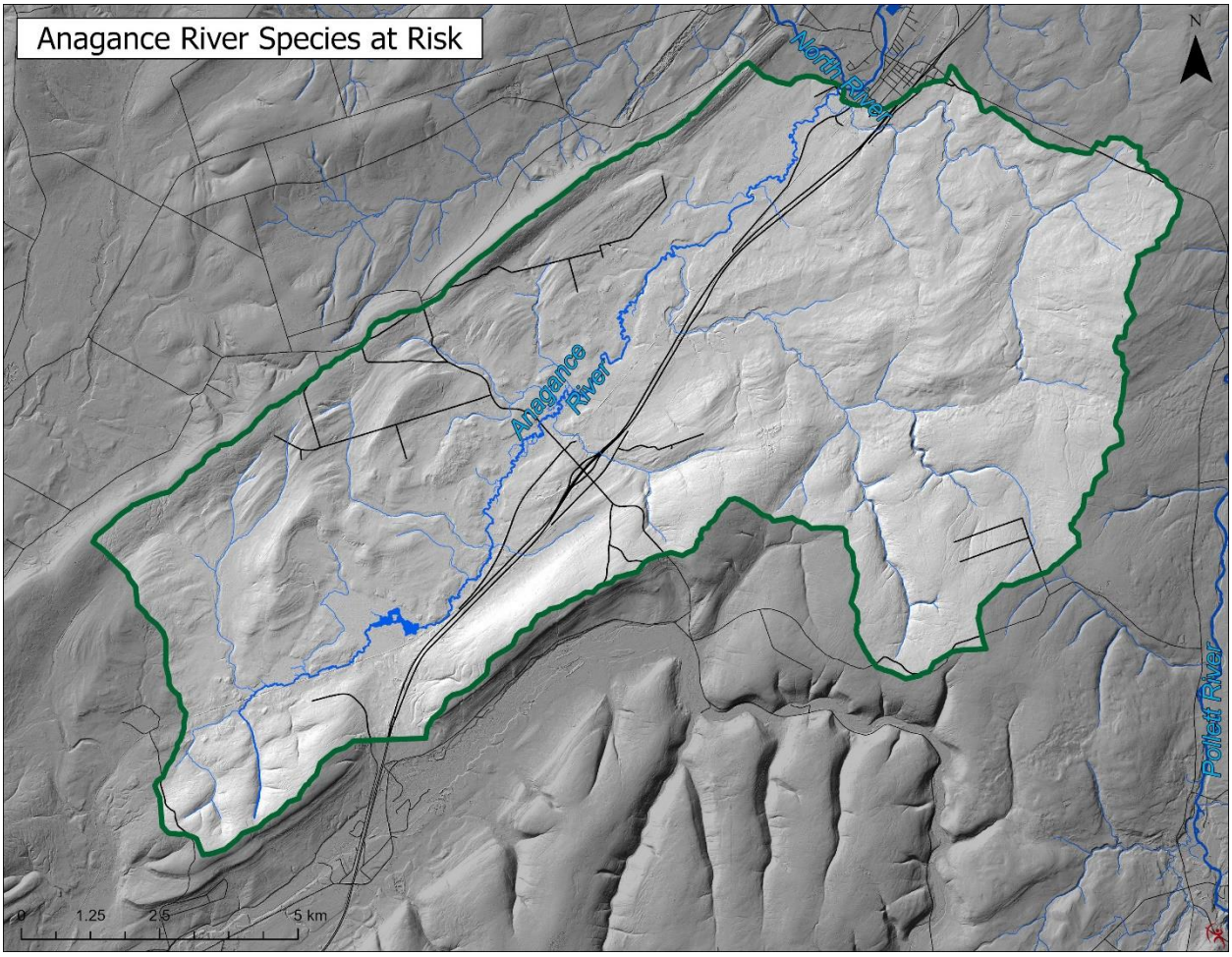

Figure 8: Locations of Encounters with SAR species on the Anagance River

As indicated in Figure 8, Fort Folly Habitat Recovery has no data on the distribution of any of these Species at Risk within the Anagance River watershed. This is due to a lack of recent field work within this watershed, rather than knowledge to suggest that they are absent. Of the three species considered here, it is reasonable to assume that eels are present, salmon are likely absent, and turtles may or may not be present.

American eels were documented on both Holmes and Hayward Brook between 1994 and 1996 during work done there by Université de Moncton for the Fundy Model Forest (Chiasson 1996). That isn't surprising, as unlike salmon, eels were not excluded by the Moncton to Riverview Causeway downstream on the Petitcodiac. In fact, while the causeway gates were closed eels were found to be the most abundant resident species

upstream of the headpond (Flanagan 2001), and one of the dominant species within the headpond (Locke et al 2000). While there is no recent data available on eel numbers within the Anagance River watershed, unlike salmon there is no reason to think that eels would have disappeared over the last 28 years. Arguably this indicates that there might be value in undertaking work within the Anagance River at some point to address this knowledge gap. The same can be said of wood turtles.

Water Quality

Water quality on Anagance River has been monitored by the Petitcodiac Watershed Alliance as part of their basin wide water monitoring program, which has data going back to 2005. The 2021 results are presented in Table 2 (Petitcodiac Watershed Alliance 2022). The PWA maintains a fixed monitoring site at the Mill Road bridge over the Anagance River just above its mouth. Other relevant sites for water as it enters the main stem are available from: North River (Route 885 Bridge); Little River (Route 112 Bridge); Pollett River (Powers Pitt Road); and the main stem (112 Bridge over the Petitcodiac in Salisbury). . Being a single site within this portion of the watershed and taken as a series of snap shots in time there is a limited amount that can be concluded from it. However, considered together with these other sites more can be gained. The fact this location has been monitored continuously by the PWA for years also provides significant time depth.

Table 3: Water Quality on the Anagance River at the Mill Road Bridge

(Petitcodiac Watershed Alliance 2022)

Monthly at Site	Dissolved Oxygen	Conductivity	Temperature °C	pH
May	12.3 mg/L	45.0 µS	8.7 °C	7.45
June	7.9 mg/L	79.4 µS	21.7 °C	7.14
July	8.9 mg/L	81.6 µS	18.7 °C	6.75
August	7.8 mg/L	81.7 µS	21.3 °C	6.88
September	8.4 mg/L	58.9 µS	18.6 °C	6.60
October	10.1 mg/L	68.6 µS	10.3 °C	6.70
Average	9.2 mg/L	69.2 µS	16.6 °C	6.80

Geomorphic Analysis

Data collected from the Rapid Geomorphic Assessment (RGA) was used to evaluate the geomorphic condition and stability of the assessed reaches North River. In order to interpret the geomorphic data, the included maps of the watercourse are highlighted according to reach stability as well as the Primary Geomorphic Processes impacting each reach.

Rapid Geomorphic Assessments are used to quantify channel stability based on the presence and (or) absence of key indicators of channel adjustment with respect to four categories: 1) Aggradation, 2) Degradation, 3) Channel Widening, and 4) Planimetric Form Adjustment. Each indicator is described in detail below.

Aggradation

Channel aggradation may occur when the sediment load to a river increases (due to natural processes or human activities), and it lacks the capacity to carry it. Piles of sediment in the river can re-direct flows against the banks, leading to erosion and channel widening.

Typical indicators used to identify aggradation include:

- Shallow pool depths.
- Abundant sediment deposition on point bars.
- Extensive sediment deposition around obstructions, channel constrictions, at upstream ends of tight meander bends, and in the overbank zone.
- Most of the channel bed is exposed during typical low flow periods.
- High frequency of debris jams.
- Coarse gravels, cobbles, and boulders may be embedded with sand/silt and fine gravel.
- Soft, unconsolidated bed.
- Mid-channel and lateral bars.

Degradation

Degradation occurs as the river cuts deeper into the land and decreases its gradient. This can occur from a rapid removal of streambed material due to an increase in discharge, water velocity, or a decrease in sediment supply. Bed lowering can move in both an upstream (as a headcut or nick point) and/or downstream direction.

Indicators of degradation include:

- Elevated tree roots.
- Bank height increases as you move downstream.
- Absence of depositional features such as bars.
- Head cutting of the channel bed.
- Cut face on bar forms.
- Channel worn into undisturbed overburden/bedrock.

Widening

Widening typically follows or occurs in conjunction with aggradation or degradation. With aggradation, banks collapse when flows are forced on the outside, and the river starts to widen. Wide, shallow watercourses have a lower capacity to transport sediment and flows continue to concentrate towards the banks. Widening can be seen with degradation, as it occurs with an increase in flows or decrease in sediment supply. Widening occurs because the stream bottom materials become more resistant to erosion (harder to move) by flowing waters than the stream banks.

Indicators of widening include:

- Active undermining of bank vegetation on both sides of the channel, and many unstable bank overhangs that have little vegetation holding soils together.
- Erosion on both right and left banks in riffle sections.
- Recently exposed tree roots.
- Fracture lines at the top of banks that appear as cracks parallel to the river, which is evidence of landslides and mass failures.
- Deposition on mid-channel bars and shoals.
- Urbanization and storm water outfalls leading to higher rate and duration of runoff and channel enlargement typically in small watersheds with >10% impervious surface.

Planform Adjustment

These are the changes that can be seen from the air when looking down at the river. The river's pattern has changed. This can happen because of channel management activities (such as straightening the bends of the river with heavy equipment). Planform changes also occur during floods. When there is no streambank vegetation with roots to hold soil in place, rivers cut new channels in the weak part of the bank during high water. Planform adjustments typically are responses to aggradation, degradation, or widening geomorphic phases.

Indicators of Planform Adjustment include:

- Flood chutes, which are longitudinal depressions where the stream has straightened and cut a more direct route usually across the inside of a meander bend.
- Channel avulsions, where the stream has suddenly abandoned a previous channel.
- Change or loss in bed form, sometimes resulting in a mix of plane bed and pool-riffle forms.
- Island formation and/or multiple channels.
- Additional large deposition and scour features in the channel length typically occupied by a single riffle/pool sequence (may result from the lateral extension of meanders).
- Thalweg not lined up with planform. In meandering streams, the thalweg typically travels from the outside of a meander bend to the outside of the next meander bend.
- During planform adjustments, the thalweg may not line up with this pattern.

Upon completion of the field inspection, indicators are tallied for each category to produce an overall reach stability index. The index classified the channel in one of three stability classes:

Table 4: RGA reach stability index classification.

Factor Value	Classification	Interpretation
≤0.20	In Regime or Stable (Least Sensitive)	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes.
0.21-0.40	Transitional or Stressed (Moderately Sensitive)	Channel morphology is within the range of variance for streams of similar hydrographic characteristics, but the evidence of instability is frequent.
≥0.41	In Adjustment (Most Sensitive)	Channel morphology is not within the range of variance and evidence of instability is widespread.

The RGA stability index results for the Anagance River are in Figure 9. Only the lowest 10 km of the river were assessed. This is the portion from the mouth of Hayward Brook to the confluence with the North River where the main stem of the Petitcodiac begins. The Anagance is a small river, and the channel upstream is too small for such assessment. Approximately 29% of the reaches are in adjustment - as per Table 4- the most sensitive state. Only 12% of the reaches assessed were found to be stable (in regime). The remaining 59% were transitional between these two states.

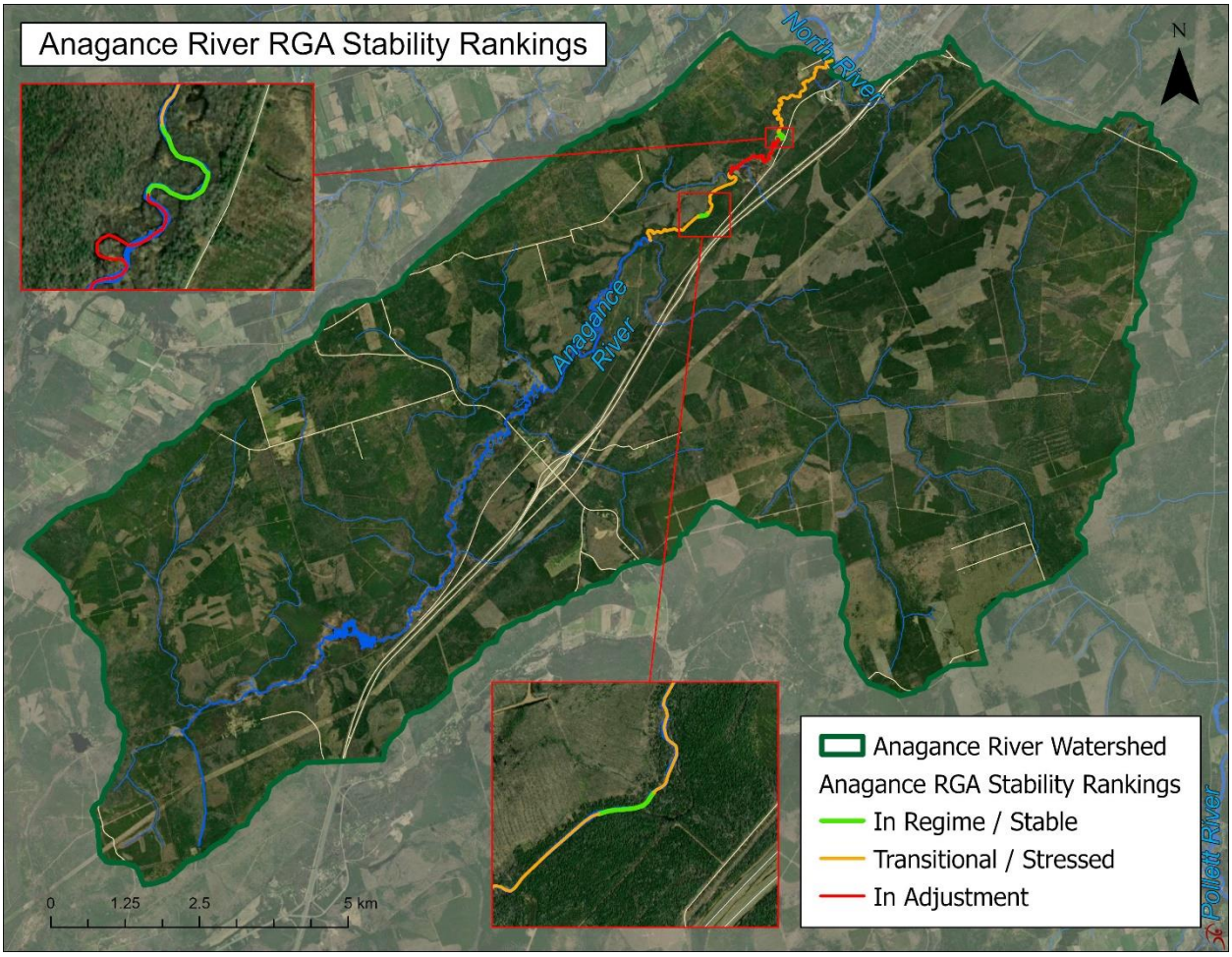

Figure 9: Stability Rankings for the Anagance River

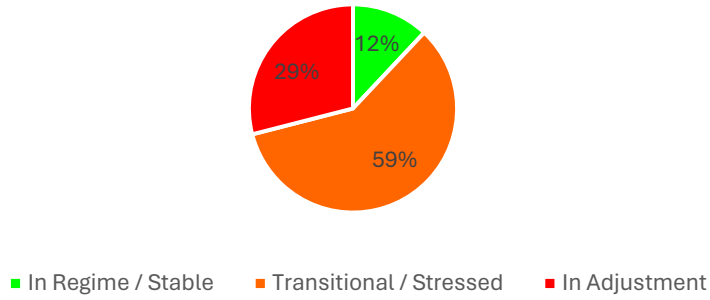

Figure 10: Anagance River Stability Index based on number of reaches.

Widening was identified as the most common primary geomorphic process (48%), with Aggradation and Degradation tying for the second most common primary process (24% each) within the Anagance River watershed. Planform adjustment accounted for the remaining 4% (Figure 11 and Figure 12). An alternating pattern of aggradation and degradation emerged with these processes either presenting as the primary condition or secondary underlying channel widening.

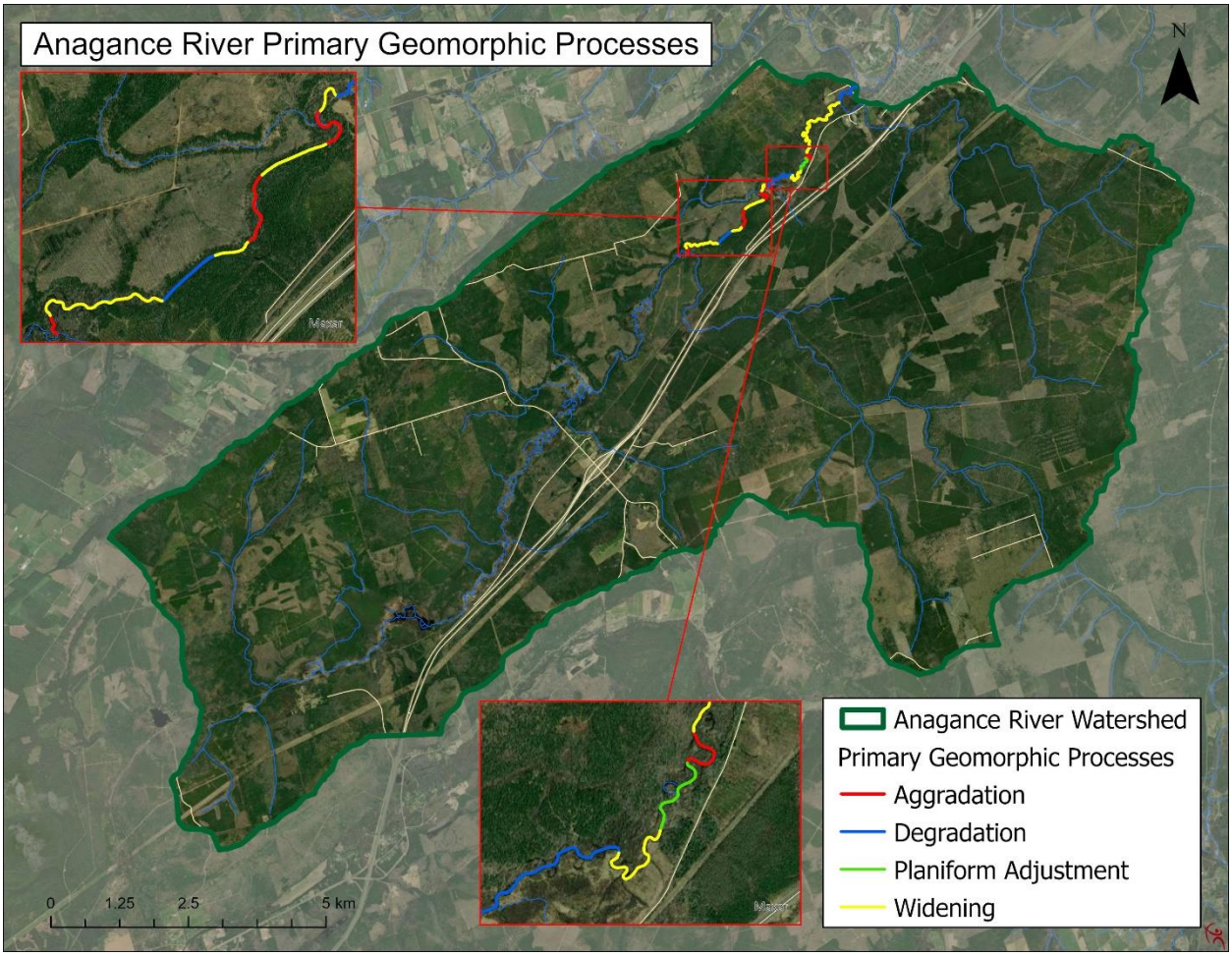

Figure 11: Primary Geomorphic Processes on the Anagance River

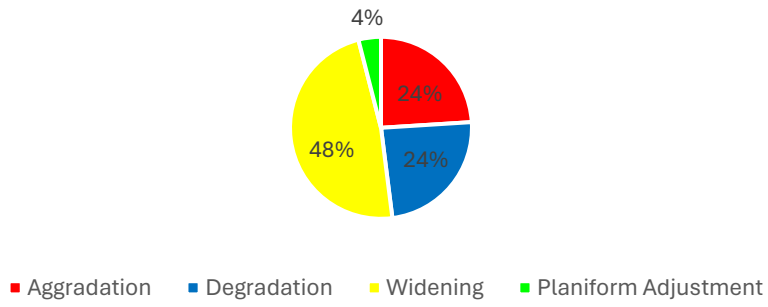

Figure 12: Primary Geomorphic Processes on the Anagance River based on number of reaches.

Channel degradation was most commonly associated with widening, particularly in the most unstable reaches. Degradation may occur when there has been a significant increase in flow, a significant decrease in sediment supply, or a significant increase in slope due to channel straightening. In the middle reaches, degradation may be a result of increased flow provided by two incoming tributaries whose watersheds are heavily developed by roadways and cleared land. Land use conditions upstream of the assessed reaches (Figure 13) may also be contributing to the pattern of aggradation and degradation observed in the upper reaches.

Figure 13: Cleared land upstream of or adjacent to assessed reaches.

Altered land use in the form of paved roadways or land cleared of mature vegetation does not hold runoff as well as vegetated or forested land. This usually results in systems with high runoff, leading to higher peak flows and discharge over a relatively short period of time. These systems are referred to as flashy watercourses. Sediments may also be originating from these areas from improperly installed or maintained road crossings. This issue is further compounded due to the condition of the underlying soils which are characterized as highly to very highly susceptible to erosion in this area of the watershed (Wall et al 2002). Further investigation is required to pinpoint the source of sediments and cause of excessive degradation in the middle reaches. The land identified in Figure 13 appears to be part of J.D. Irving's Industrial Freehold (Figure 4) and the clearings are clear cuts. Historical imagery confirms this (Figure 14). Most of that harvesting is quite recent – part of the May 2015 image appears to freshly harvested, with additional cutting by April 2016.

Figure 14: Comparison between May 14th 2015 and April 29th 2016

Fourth Level Assessment - Aquatic Habitat Rehabilitation Plan

Summary of Issues Identified from Current Impacts

The Broken Brooks culvert survey by the PWA (Petitcodiac Watershed Alliance 2017) visited 11 out of 69 identified water-crossings in the Anagance watershed identifying six bridges and five culverts. Among these they noted two that allowed fish passage, two culverts that were partial barriers (due to debris and excessive outflow drops) and one that is a full barrier to fish passage (Figure 7). That small sample suggests that of the 58 or so remaining water-crossings identified during the GIS analysis, there are likely quite a few that may require remedial work of some kind.

Going forward, a first step ought to be to complete the culvert survey of the watershed, to find and prioritize those crossings needing the most urgent attention. The PWA has focused their Broken Brooks project outside of the Anagance since 2017. That need is highlighted here, to try to keep it on the agenda for future work, whether PWA or FFHR.

Summary of Issues Identified by Aquatic and Riparian Habitat Assessment

Much like the lack of current or comprehensive culvert data, there is a lack of Species at Risk data from within this watershed. In both cases this is in large part because Anagance does not offer the same conservation value as the Pollett River or the Little River where

salmon recovery efforts are targeted due to the importance of the spawning gravel in those tributaries. That said, the absence of data makes for a circular argument on this issue, leaving the real conservation value of this habitat harder to rank relative to other Petitcodiac tributaries.

It is reasonable to assume that Atlantic almon, American eels, or wood turtles could be present. Of the three, eels and wood turtles are both almost certainly present, while salmon are a strong enough possibility to warrant occasional monitoring – certainly prior to undertaking any intervention. Consequently, projects must be planned and implemented with awareness of the vulnerabilities of these species. Fort Folly Habitat Recovery has developed project checklists (Appendix A) based on species biology to provide guidelines to help avoid or minimize the risk of negative impacts of projects on these species.

Analysis of the RGA assessments conducted on the lower main stem of the Anagance River indicate that most of the reaches were determined to be in a transitional/stressed state while the remaining reaches were classified as in adjustment or in regime. One area in particular (reach 13) stood out as heavily impacted: RGA (Figure 11) – in adjustment, with channel widening. Reach 13 stood out as the most heavily impacted site within the Anagance watershed, but not within the Petitcodiac overall. Sites in greater need of intervention exist on both the Little River and the Pollett River. Ongoing salmon stocking efforts on both of these rivers elevate the immediate restoration priority of sites there compared to similar sites on the Anagance River. In general, the RGA results indicate that the Anagance watershed is responding to change with widening as the primary geomorphic process and degradation and aggradation as the secondary processes. Therefore, when restoration efforts are eventually undertaken, these should establish proper channel widths, ensure connection to the floodplain and promote sediment accumulation.

Reaches with excessive sediment accumulation could be restored via in-channel structures including rock vanes, upstream-V log weirs, double tree deflectors, and brush mattresses. These structures are designed to concentrate flows, promote scour pools, and narrow the channel. By narrowing the channel, the stream will regain the capacity to transport sediment as flow velocity will increase. In degrading sections of stream, rock toe structures and bank treatments can be used to establish proper channel dimensions. Structures highlighted above may also be used in degraded sections to encourage deposition in the proper areas and establish connection to the floodplain. This will encourage the channel to return to a state of dynamic equilibrium where sediment accumulation and deposition balance with flow discharge.

It is important that restoration structures be designed to fit the natural channel dimensions and hydraulic conditions of the site. Improperly placed or installed structures may do more harm than good. Logs used for structures should be freshly cut (dry logs will float, making installation difficult) and contain no rot. Recommended tree species are cedar, hemlock or spruce. If anchor stones are used for log weir/log deflector support, the rocks

should be angular rather than round as round rock fits poorly and tends to roll easily. A detailed site survey including longitudinal and cross-sectional profiles, pebble counts, and riparian topography is necessary to appropriately identify a restoration strategy for a site. At the watershed scale, best management practices should be promoted to improve the stability of the Anagance River. Although pasture constitutes a low proportion of the watershed, the most degraded sections exist where agricultural is concentrated along the riparian corridor. Many of the assessed reaches of the Anagance River were identified as in adjustment and lack adequate riparian conditions due to surrounding land use. Shrub and tree planting would provide greater stability and habitat along banks that currently lack cover and will reduce sediment input. Pasture along the channel should be restricted from river access to promote vegetation growth along the riparian corridor and to improve water quality. Any opportunities to reforest the riparian corridor will lower water temperatures, reduce sediment input, minimize non-point source pollution and improve stability.

Restoration Activities Undertaken

The only restoration activity that has been done within the Anagance watershed was in 2017 when the PWA cleared debris at culvert C-147 (Figure 15) where Highway 1 crosses Holmes Brook (Petitcodiac Watershed Alliance 2017). The debris was assessed as

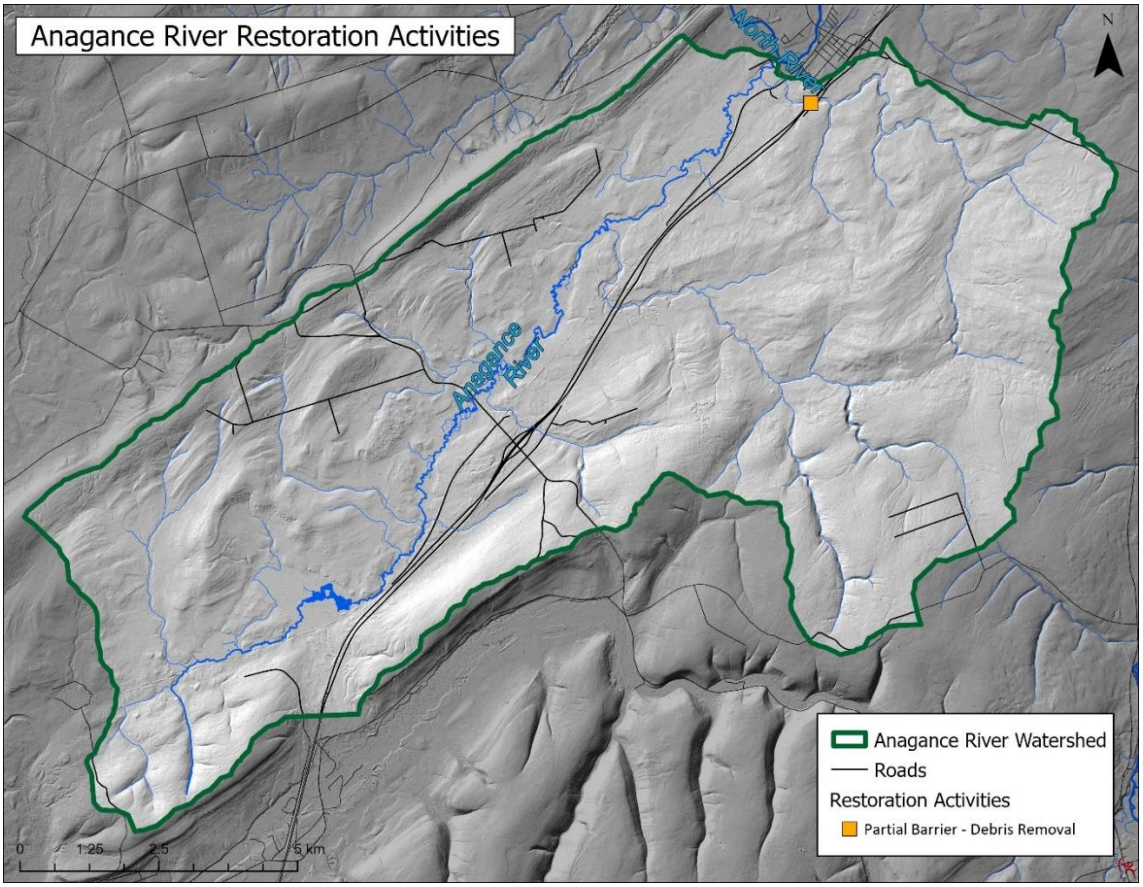

Figure 15: Restoration Activities Undertaken within Anagance River watershed.

creating a partial barrier to fish passage at that site. This work opened up approximately 10 km of upstream habitat- but this debris may well have reaccumulated over the last 7 years for the same reasons that it did previously, and so by now may once again be creating a barrier to fish passage.

Opportunities for Future Restoration Activities

Restoration Framework –Stewardship Planning, Prioritization and Engagement

To address concerns within the watershed through an efficient use of finite resources (both human and financial), projects must be well prioritized, both in terms of the needs of the river, and those of the landowners on who's property the project is taking place. Fort Folly Habitat Recovery has developed a series of Stewardship Plans on a watershed-by-watershed basis within the Petitcodiac River system, of which this Stewardship Plan for the Anagance River is one. These plans provide a means of tackling the challenging task of identifying local problems, determining which ones warrant immediate attention, and determining how to proceed with them once chosen. This process is laid out in Figure 16 and Figure 17.

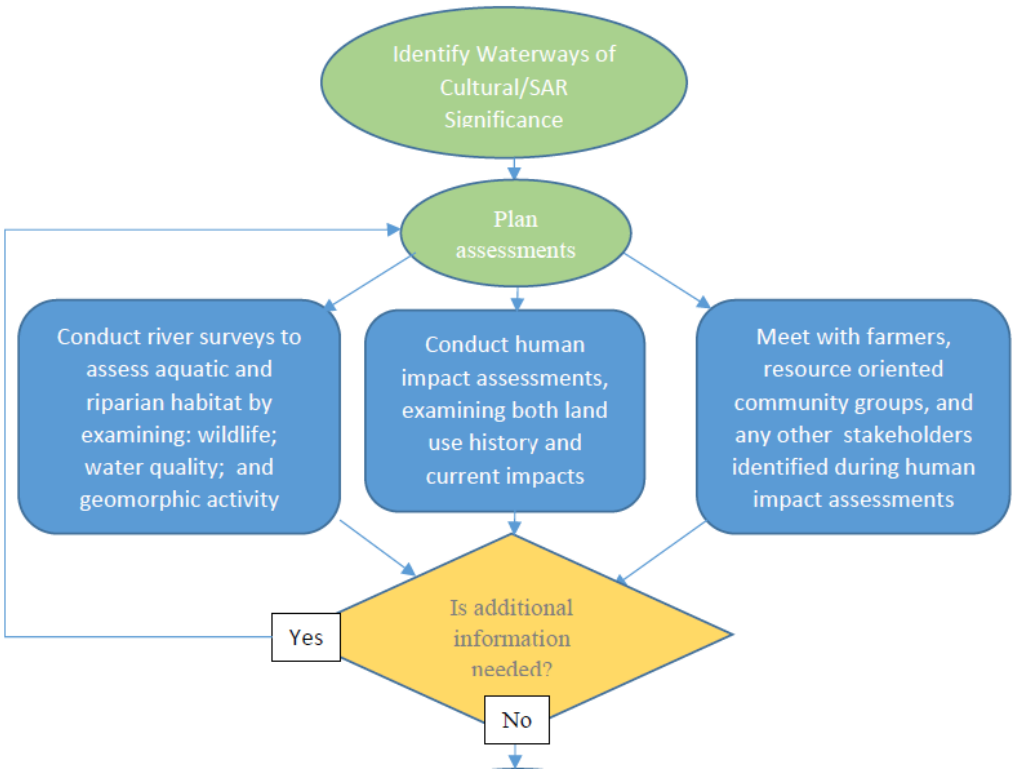

Figure 16: Stewardship Planning Process Part 1: Needs of the River

The field work for the Third Level Assessment (Aquatic and Riparian Habitat Assessment) informs decision making by providing the context necessary to prioritize and target project selection. Without it, decisions about which project to undertake would be made without proper appreciation of how needs at a given site compare to those at other sites elsewhere in the system. At this point there is also an opportunity to ensure that efforts are well distributed across the watershed by including consideration of where previous projects have been done, to avoid focusing too much effort in one area.

Applying such information, project selection can then proceed along the flowchart presented in Figure 33, where once identified, potential projects can be ranked according to their anticipated impact and viability. Viability is determined in part by the costs and benefits of the project, but is also dependent upon landowner interest, which comes from (to the extent practical) incorporation of landowner input into planning the project so that it is consistent with the landowner's needs.

Following this two-part selection process not only aids in decision making within the organization, doing so subsequently builds the case for any individual project when pursuing resources from outside the organization to undertake it, by providing the evidence

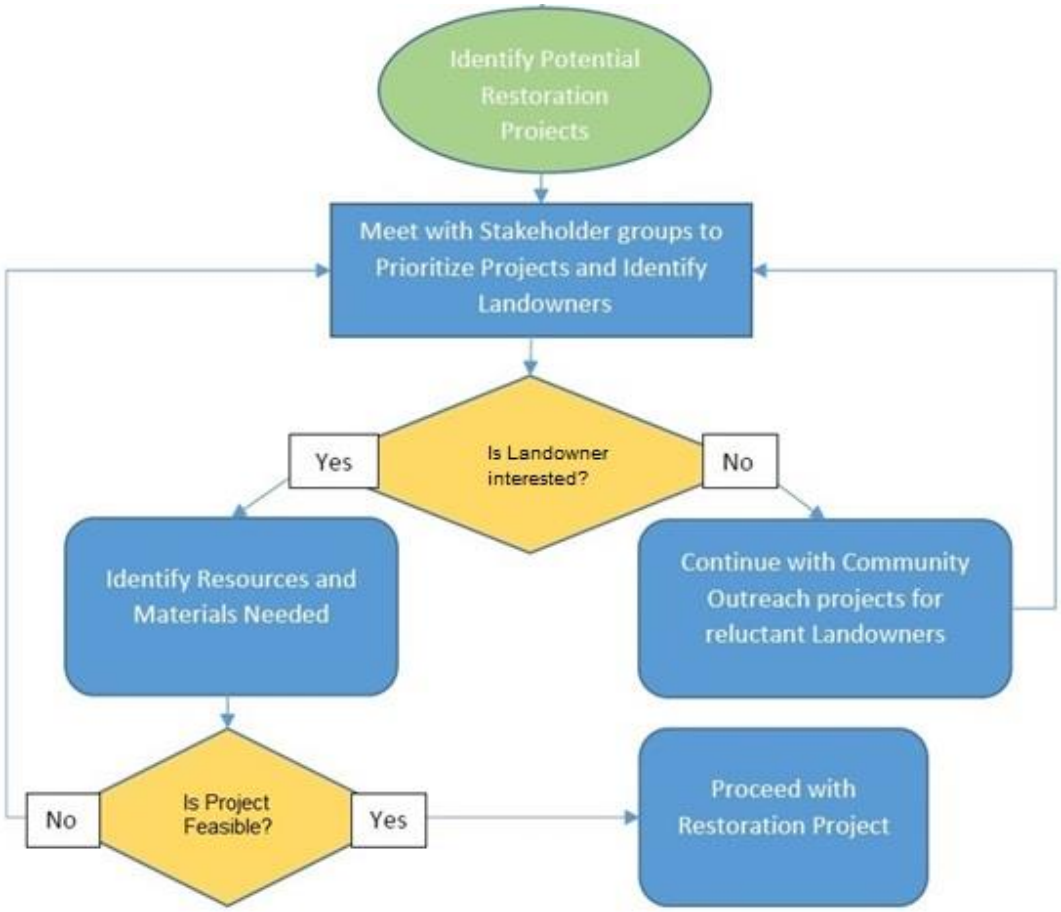

Figure 17: Stewardship Planning Process Part 2: Meeting Landowner Needs

to explain to others why it is necessary. This also creates further opportunities for outreach and engagement with landowners, through accessing and participating in existing social networks. Only once a project has been determined to be both worthwhile and feasible through this process should it then proceed to the design phase.

Given finite resources, the value of a project with regards to advancing salmon recovery is one of the strongest considerations in prioritizing project selection within the Petitcodiac as a whole. The detection of numerous iBoF Atlantic salmon redd sites in both the Little River and the Pollett River from 2011 onward demonstrates the importance of the spawning gravel in both Petitcodiac tributaries. Consequently, work within those tributary watersheds is of necessity, a greater priority than along the main stem. Projects on the main stem of the Petitcodiac come at the expense of undertaking similar projects elsewhere that, regarding salmon recovery, are likely to yield greater benefits. The main stem serves mostly as a travel corridor that salmon, such as the wild return caught at the head-of-tide in 2021, pass through to access those tributaries. Likewise, the precocious parr seen in 2023 came out of those tributaries looking for returning adults. That being the case, work within those tributaries likely provides the greatest benefit to salmon being seen on the main stem.

References

Allison, D. (1916). The History of Nova Scotia. Volume 2. A.W. Bowen & Company, Halifax Nova Scotia. 570 pages. https://archive.org/details/historyofnovasco02alliuoft Web April 9th, 2020.

AMEC (2005) Environmental Impact Assessment Report for Modifications to the Petitcodiac River Causeway. Submitted to New Brunswick Department of Supply and Services by AMEC Earth and Environmental. Fredericton, New Brunswick. 376 pages.

Andrews, C. (1943). Smolt marking on the North River, Petitcodiac, N. B. Fisheries Research Board of Canada, Manuscript reports of the biological stations 335; Atlantic salmon and trout investigations, 1943; 28(1): 9 pages.

Beaulieu, A. (2014). "Under his majesty's protection": The meaning of the conquest for the aboriginal peoples of Canada. Chapter 4 In: The Culture of the Seven Year's War. Bruyn, F. and S. Regan eds. University of Toronto Press. Pages 91-115.

Beck, J.M. (1979). Cornwallis, Edward. In: Dictionary of Canadian Biography Volume 4. University of Toronto/Université Laval. 913 pages.

Bowser, R. (1986). Dorchester Island and Related Areas. Dorchester New Brunswick. 178 pages.

Burrows, J. (1984). Petitcodiac: A village History. Bicentennial Commission. 112 pages.

Canadian Broadcasting Corporation. (2014). Interactive Map of New Brunswick's Shale Gas Industry. Web 5 March 2014. http://www.cbc.ca/nb/features/fracturedfuture/rights_map.html

Canadian Broadcasting Corporation. (2015). SWN Resources granted exploration license extension despite moratorium. Web March 17th, 2015. http://www.cbc.ca/news/canada/new-brunswick/swn-resources-granted-exploration-licence-extension-despite-moratorium-1.2998711

Canadian Broadcasting Corporation. (2018). Fracking poised to be key issue in new legislature. Web March 19th, 2019. https://www.cbc.ca/news/canada/new-brunswick/cbc-new-brunswick-political-panel-podcast-1.4898039

Chiasson, A. (1996). Effects of Riparian Zone Management on Fish Community Structure: Hayward and Holmes Brook Study: Final Report 1995. Fundy Model Forest, Sussex New Brunswick. 30 pages.

Chipman, W. (1784). Letter to Edward Winslow, March 7th, 1784. Winslow Family Papers, Volume 3-62 https://web.lib.unb.ca/winslow/partition.html Web August 12th, 2020.

Commissioner of Fisheries. (1877). Report of the Commissioner of Fisheries: Supplement No. 4 to the Ninth Annual Report of the Minister of Marine and Fisheries for the year 1876. Ottawa, Ontario. 387 pages.

COSEWIC. (2006). COSEWIC assessment and status report on the American eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 71 pages.

COSEWIC (2007) COSEWIC assessment and status report on the Wood Turtle Glyptemys insculpta in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 49 pages.

COSEWIC (2011) Species Database: Turtle, Wood. http://www.cosewic.gc.ca/eng/sct1/searchdetail_e.cfm?id=286 Web 6 March. 2014.

COSEWIC (2014) Species Database: Eel, American. http://www.cosewic.gc.ca/eng/sct1/searchdetail_e.cfm?id=891 Web 31 Dec. 2014.

Dallison, R. (2003). Hope Restored: The American Revolution and the Founding of New Brunswick. The New Brunswick Military Heritage Series, Volume 2. Goose Lane Editions, Fredericton, New Brunswick. 126 pages.

Dawson, J. (2005). Historical Atlas of the Maritime Provinces 1878. Reprinting the Atlas of the Maritime Provinces of the Dominion of Canada, A. Rowe and W. Rowe, 1878 St John New Brunswick. Nimbus Publishing Ltd. Halifax, Nova Scotia. 72 pages.

DeMerchant, E. (1983). From Humble Beginnings: The Story of Agriculture in New Brunswick. New Brunswick Department of Agriculture and Rural Development, Fredericton. 94 pages.

Department of Natural Resources (2007). Our Landscape Heritage. The Story of Ecological Land Classification in New Brunswick. Second Edition. Fredericton. 359 pages.

Department of Natural Resources (2014). Forestry and Transportation GIS Data.

DFO (2010). Aquatic Species at Risk – Atlantic Salmon Inner Bay of Fundy. http://www.dfo-mpo.gc.ca/species-especes/species-especes/salmon-atl-saumon-eng.htm Web 6 March. 2014.

Dunfield, R. (1991). Notes on fisheries resources of the Petitcodiac River basin. Canada Dept. of Fisheries and Oceans. Halifax, Nova Scotia. Unpublished manuscript. 12 pages.

Elliot, M. (1970). A History of Anagance Ridge. 41 pages.

Elson, P. (1961). Proposed Moncton causeway-aboideau in relation to anadromous fish of the Petitcodiac system. Unpublished report, Fisheries Research Board of Canada. January 31 1961. 9 pages.

Elson, P. (1962). Predator-prey relationships between fish eating birds and Atlantic salmon (with a supplement on fundamentals of merganser control). Bulletins of the Fisheries Research Board of Canada Bulletin No. 133. Ottawa.

Evans, D. (2004). Building the Steam Navy: Dockyards, Technology and the Creation of the Victorian Battle Fleet, 1830 to 1906. Chrysalis Books Group. London, England. 208 pages.

Faragher, J. (2005). A Great and Noble Scheme: The Tragic Story of the Expulsion of the French Acadians from Their American Homeland. W.W. Norton and Company, New York, New York. 562 pages.

Fellows, R. (1971). The Loyalists and Land Settlement in New Brunswick, 1783-1790: A study in Colonial administration. The Canadian Archivist 2(2): 5-15.

Flanagan, J.J.(2001). Fish Monitoring Activities within the Petitcodiac River Basin Upstream of the Petitcodiac River Causeway, 2000. Unpublished report prepared for Fisheries and Oceans Canada. Pp 13-16. In Locke, A. (Ed.) 2001. Annotated bibliography of aquatic biology and habitat of the Petitcodiac River system, New Brunswick, Part 2. Can. Manuscr. Rep. Fish. Aquat. Sci. no. 2561: iii+62pp.

Fort Folly First Nation. (2021). Fort Folly Land Claim. https://fortfolly.ca/land-claim-submission Web January 21st, 2021.

Francis, J., R. Jones, and D. Smith. (2010). Journeys: A History of Canada. 6th Edition. Nelson Education Ltd. Toronto, Ontario. 641 pages.

Ganong, W. (1896). A Monograph of the Place-Nomenclature of the Province of New Brunswick. (Contributions to the History of New Brunswick – No. 2). Transactions of the Royal Society of Canada, Second Series, Volume 2, Section 2, pages 175-289.

Ganong, W. (1899). A Monograph of Historic Sites in the Province of New Brunswick. (Contributions to the History of New Brunswick – No. 4). Transactions of the Royal Society of Canada, Second Series, Volume 5, Section 2, pages 213-357.

Ganong, W. (1901). A Monograph of the Evolution of the Boundaries of the Province of New Brunswick. (Contributions to the History of New Brunswick – No. 5). Transactions of the Royal Society of Canada, Second Series, Volume 7, Section 2, pages 139-449.

Ganong, W. (1905). A Monograph of the Origins of the Settlements in New Brunswick (Contributions to the History of New Brunswick - No. 5) Transactions of the Royal Society of Canada, Second Series, Volume 7, Section 2, pages 139-449.

Ganong, W. (1914). Supplement to Note 131 – The Ancient Indian Portages from the Washademoak to Adjacent Waters in On the Physiographic Characteristics of the Washademoak-Canaan River. Bulletin of the Natural History Society of New Brunswick, Volume 7, Number 31, Part 1, pages 1-37.

Ganong, W. (1930). The report and map of Major George Scott's expedition to remove the French from the Petitcodiac in 1758. New Brunswick Historical Society 13: 97-114

Geological Survey of Canada. (1890). Summary Reports on the Operations of the Geological Survey for the years 1888 and 1889. Geological and Natural History Survey of Canada. Montreal, Quebec.

Gilroy, M. (1933). The Partition of Nova Scotia, 1784. Canadian Historical Review 14(4): 375-391.

Government of New Brunswick. (2023a). News Release. Bridge between Moncton and Riverview to be named after late senator and MLA. October 5th, 2023. Available online:
https://www2.gnb.ca/content/gnb/en/departments/women/news/news_releases.2023.10.0507.html

Government of New Brunswick. (2023b). Local Governance Reform: Working together for vibrant and sustainable communities. https://www2.gnb.ca/content/gnb/en/corporate/promo/local-governance.html Web February 27th 2023.

Government of New Brunswick. (2024). GeoNB Oil and Natural Gas (ONG) Viewer. http://geonb.snb.ca/ong/index.html Web February 19th, 2024.

Goodrich, E. (2010). Stagecoach Days on the Westmorland Great Road 1835-1872. Westmorland Historical Society. 196 pages.

Goodrich, G. (2020). Dorchester's Mi'kmaq. Westmorland Historical Society Newsletter. Volume 55(3): 4-14.

Gordon, G. (2014). When Money Grew on Trees: A. B. Hammond and the Age of the Timber Baron. The University of Oklahoma Press. Norman, Oklahoma. 496 pages.

Goudge, M. (1934). Limestones of Canada: Their Occurrence and Characteristics. Part II: Maritime Provinces. Canada Department of Mines, Mines Branch, No. 742. Ottawa. 186 pages.

Grenier, J. (2008). The Far Reaches of Empire: War in Nova Scotia 1710-1760. University of Oklahoma Press. Norman, Oklahoma. 270 pages.

Hamilton, J. (1961). Salt in New Brunswick. Geological Division, Mines Branch, Fredericton New Brunswick. 73 pages + Map.

Hodges, G. (1996). The Black Loyalist directory: African Americans in exile after the American Revolution. Garland Publishing, New York. 318 pages.

Huntsman, A. (1941). Report on selection of a stream for a practical experiment in planting young salmon. Fisheries Research Board of Canada, Manuscript reports or the biological stations 212; Atlantic salmon and trout investigations, 1941; 22(4): 18 pages.

Huntsman, A. (1944). Relation of beaver to salmon. Fisheries Research Board of Canada, Manuscript reports of the biological stations 379; Atlantic salmon and trout investigations, 1944; 30(1): 8 pages.

Huntsman, A. (1945). Assessing stream populations of young salmon. Fisheries Research Board of Canada, Manuscript reports of the biological stations 381; Atlantic salmon and trout investigations, 1945; 32(1): 10 pages.

Johnston, J. (1851). Notes on North America, Agricultural, Economical, and Social. Volume 1. Blackwood and Sons. London, England. 415 pages.

Kernaghan, L. (1981). A man and his Mistress: J.F.W. Des Barres and Mary Cannon. Acadiensis 11(1): 23-42.

Larracey, E. (1985). Chocolate River: A story of the Petitcodiac River from the Beginning of Habitation in the Late 1600's Until the Building of the Causeway at Moncton. Lancelot Press Ltd. Hantsport, Nova Scotia. 254 pages.

Laxer, J. (2006) The Acadians: In Search of a Homeland. Doubleday Canada, Toronto, Ontario. 336 pages.

Locke, A., J. Hanson, G. Klassen, S. Richardson, C. I. Aubé. (2003) The Damming of the Petitcodiac River: Species, Populations, and Habitats Lost. Northeastern Naturalist Vol. 10. No. 1. 39-54.

MacEachern, N. (1965). Anadromous fish affected by the proposed Moncton causeway on the Petitcodiac River. Memo to C.P. Ruggles. Fisheries Service, Department of the Environment, . December 15 1965. 3 pages.

MacNutt, W. (1963). New Brunswick A History: 1784-1867. MacMillan of Canada, Toronto. 496 pages.

MacNutt, W. (1970). The making of the Maritime Provinces 1713-1784. The Canadian Historical Association Booklets. No. 4. Ottawa, Ontario. 21 pages.

Mancke, E. (2005). Spaces of Power in the Early Modern Northeast. In: New England and the Maritime Provinces: Connections and Comparisons. Hornsby, S., and J. Reid, editors. McGill-Queen's University Press. Montreal, Québec. 424 pages.

Mancke, E. (2019). Decorous Dispossession: Legally Extinguishing Acadian Landholding Rights. Blog post: https://earlycanadianhistory.ca/2019/07/30/decorous-dispossession-legally-extinguishing-acadian-landholding-rights/ Web April 29th, 2020

Marble, A. (1993). Surgeons, smallpox, and the poor in Nova Scotia 1749 -1799. McGill-Queen's University Press. Montreal, Québec. 376 pages.

Marshall, D. (2011). Heroes of the Acadian Resistance: The story of Joseph Beausoleil Broussard and Pierre II Surette 1702-1765. Formac Publishing Company, Ltd. Halifax. Nova Scotia. 207 pages.

Martin, C. (1995). Fort Beauséjour (New Brunswick, Canada). In: International Dictionary of Historic Places: Volue 1, Americas. T. Ring, N. Watson, and P. Schellinger eds. Routledge, London. Pages 218 to 222.

Melanson, T., Murphy, L., Goff, D., MacInnis, C., Keen, D., Bastien-Daigle, S., Ritchie, B., Ferguson, E., Haché, D., Weldon, J., Caissie, D., LeBlanc, M., Cormie, M. (2006). Ecological Restoration of Degraded Aquatic Habitats: a Watershed Approach. Gulf Region Publication. 180 pages.

Mi'gmawe'l Tplu'taqnn. (2023). MTI Communities initiate process for Mi'gmaq Title Recognition. Press Release February 15th, 2023. Mi'gmawe'l Tplu'taqnn Incorporated. Natoaganeg, NB.

Miller, V. (1976). Aboriginal Micmac Population: A review of the evidence. Ethnohistory 23(2): 117-127

Milner, W. (1911) Records of Chignecto. In: Collections of the Nova Scotia Historical Society Volume 15. McNab and Son. Halifax, Nova Scotia. 86 pages.

Milner, W. (1967). Early History of Dorchester and the Surrounding Area. Second Edition, reprint of 1932. 37 pages.

Mooney, J. (1928). The aboriginal population of America north of Mexico. Smithsonian Institution, Miscellaneous Collections 80 (7): 1-40

Natural Resources Canada. (1997). Petitcodiac, New Brunswick. Topographic Map, 1:50,000. 21-H/14, 4th Edition. Centre for Topographic Information, Ottawa.

New Brunswick Department of Agriculture. (1892). Report on Agriculture for the Province of New Brunswick for the year 1891. New Brunswick Department of Agriculture. Fredericton, New Brunswick. 272 pages.

New Brunswick House of Assembly. (1890). Journals of the House of Assembly of the Province of New Brunswick. First Session of the Twenty Seventh General Assembly, Fredericton. 138 pages +xxxiii.

New Brunswick Railway Museum. (2015). Riding the Rails 03: European and North American Railway. Web March 10th 2015. http://www.virtualmuseum.ca/sgc-cms/histoires_de_chez_nous-community_memories/pm_v2.php?id=story_line&lg=English&fl=0&ex=398&sl =2789&pos=1

Norman, G. (1932). Salt Deposits of Nova Scotia and New Brunswick. Pages 28-35 In: Summary Report, 1931 Part D. Canada Department of Mines. Geological Survey. No. 2306. Ottawa Ontario.

Nova Scotia Archives (2020). Peace and Friendship Treaties at the Nova Scotia Archives. https://archives.novascotia.ca/mikmaq/results/?Search=AR5&SearchList1=all&TABLE2=on Web January 12th, 2021.

Parker, G. (2015). Workin' in the Woods: Toil for Timber in Early Mew Brunswick. Gerry Parker, Sackville, New Brunswick. 284 pages.

Patterson, S. (1993). Indian-White relations in Nova Scotia: 1749-61: A study in Political Interaction. Acadiensis 23 (1): 23-59.

Patterson, S. (2009). Eighteenth-Century Treaties: The Mi'kmaq, Maliseet, and Passamaquoddy Experience. Native Studies Review 18 (1): 25-52.

Paul, D. (2000). We Were not the Savages: A Micmac Perspective on the Collision of European and Aboriginal Civilization. Fernwood Publishing Co. Ltd. 359 pages.

Perley, M. (1841). Reports on Indian Settlements, extracts from Mr. Perley's First Report Respecting the Indians on the Saint John. Journal of the House of Assembly of the Province of New Brunswick from the Nineteenth day of January to the Fourth day of April, Being the Sixth Session of the Twelfth General Assembly. John Simpson. Fredericton, New Brunswick.

Perley, M. (1857) Hand-Book of Information for Emigrants to New-Brunswick. Edward Stanford. London, England. 95 pages.

Petitcodiac River Heritage Committee. (2000). The Petitcodiac River System Shepody Bay Estuary. Pre-screening Report submitted to the Canadian Heritage Rivers Board. Moncton. 18 pages.

Petitcodiac Watershed Alliance. (2010). Little River Habitat Assessment. Petitcodiac Watershed Alliance. Moncton, New Brunswick. 31 pages.

Petitcodiac Watershed Alliance. (2016). Water Quality within the Petitcodiac River Watershed. Petitcodiac Watershed Alliance. Moncton, New Brunswick. 56 pages + Appendices.

Petitcodiac Watershed Alliance (2017). Broken Brooks 2014-2016: Restoring Fish Passage in the Petitcodiac Watershed. Petitcodiac Watershed Alliance, Moncton New Brunswick. 67 pages.

Petitcodiac Watershed Alliance (2022). Water Quality Monitoring: Making Waves in Environmental Stewardship. Petitcodiac Watershed Alliance, Moncton New Brunswick. 134 pages.

Philipps, R. (1720). Governor of Nova Scotia to Board of Trade, 27th September 1720. United Kingdom National Archives. CO217/3. No.18

Pincombe, A. and E. Larracey. (1990). Resurgo: The History of Moncton . Volume 1: The History of Moncton From its Beginning to Incorporation as a City in 1890. City of Moncton, New Brunswick. 448 pages.

Pomeroy, J. (2002). Stream Turbidity Signatures Within the Hayward Brook Watershed Study. M.Sc. Thesis, Faculty of Forestry and Environmental Management, University of New Brunswick. Fredericton. 169 pages.

Prins, H. (1996). The Mi'kmaq Resistance, Accommodation, and Cultural Survival. Harcourt Brace College Publishers. Fort Worth Texas. 250 pages.

Provincial Archives of New Brunswick (2017). Where is Home? New Brunswick Communities Past and Present. Web 14 March 2017. http://archives.gnb.ca/exhibits/communities/Home.aspx?culture=en-CA

Pugh, K. (1999). Status of Riparian Zones in the Anagance Watershed. Fundy Model Forest. Sussex, New Brunswick. 31 pages.

Purvis, T. (1999). Colonial America to 1763. Almanacs of American Life. Facts on File Inc. Infobase Publishing. New York, New York. 381 pages.

Raymond, W. (1891). Paper on the Early Days of Woodstock. Proceedings at the Centennial Commemoration of the ordination of Rev. Frederick Dibblee. Saint John, New Brunswick. 28 pages.

Redfield, E. (2024) Petitcodiac Fish Trap Results, 2023 Season. Fort Folly Habitat Recovery, Dorchester New Brunswick. 40 pages.

Reid, J. (2013). The three lives of Edward Cornwallis. Journal of Nova Scotia Historical Society 16: 19-45.

Ritchie, G. (1996). Trees of Knowledge: A Handbook of Maritime Trees. Tree Plan Canada. Canadian Forest Service, Atlantic Forestry Centre. Fredericton, New Brunswick. 41 pages.

Sanderson, S. (2017). Constitution Act 1982: Implementation of Section 35 (1) and (2). Federation of Sovereign Indigenous Nations. Saskatoon, Saskatchewan. 4 pages.

SARA Registry (2012, July 6th) Species at Risk Public Registry- Species Profile (*Glyptemys insculpta*). http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=286 Web 6 March. 2014.

SARA Registry (2013a) Species at Risk Public Registry- Species Profile (*Salmo salar*). http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=672 Web 6 March. 2014

SARA Registry (2013b) Species at Risk Public Registry- Species Profile (Anguilla rostrata). http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=891 Web 6 March. 2014.

Scott, G. (1758). Draught of the River Pittuiquack in the Bay of Fundy. Map produced during Major Scott's expedition on the Petitcodiac. Available as part of display at Fort Beausejur - Fort Cumberland National Site of Canada, Aulac NB.

Scott, W., and M. Scott. (1988). Atlantic Fishes of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences 219. 731 pages.

Snowdon, J. (1983) Botsford, Amos. In: Dictionary of Canadian Biography Volume 5. University of Toronto/Université Laval. 1,044 pages.

Squires, L. (2000). Loyalist Settlement in New Brunswick. The New Brunswick Loyalists. In: Loyalists of the Maritimes. Page 27–38. United Empire Loyalists Association of Canada.

Statistics Canada. (2017). Cardwell Parish, New Brunswick. Census Profile: 2016 Census. Web, March 13th 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?B1=All&Code1=1305026&Code2=13&Data=Count&Geo1=CSD&Geo2=PR&Lang=E&SearchPR=01&SearchText=Cardwell&SearchType=Begins&TABID=1

Statistics Canada. (2020). Aboriginal Peoples. Censuses of Canada 1665 to 1871. https://www150.statcan.gc.ca/n1/pub/98-187-x/4151278-eng.htm Web April 2nd, 2020

Stronach, I. (1969). The European and North American Railway. Canadian Rail 206:15-19.

Upton, L. (1974). Indian affairs in Colonial New Brunswick. Acadiensis 3(2):3-26.

Village of Petitcodiac. (2015). History. Web March 10th 2015. http://www.villageofpetitcodiac.com/vopCommunityHistory.php

Wall, G.J., D.R. Coote, E.A. Pringle and I.J. Shelton (editors). 2002. RUSLEFAC — Revised Universal Soil Loss Equation for Application in Canada: A Handbook for Estimating Soil Loss from Water Erosion in Canada. Research Branch, Agriculture and Agri-Food Canada. Ottawa. Contribution No. AAFC/AAC2244E. 117 pp.

Walls, M. (2010). No Need of a Chief for This Band: The Maritime Mi'kmaq and Federal Electoral Legislation, 1899 to 1951. University of British Columbia Press. Vancouver, British Columbia. 216 pages.

Washburn and Gillis Associates Ltd. (1994). Suggested watershed management and freshwater and anadromous fisheries improvement opportunities – Moncton region. Washburn and Gillis Associates Ltd., Fredericton, NB. Report to Recreational Fisheries Division, Dept. of Fisheries and Oceans, Moncton, NB. February 10 1994. vii+105 p.

Wicken, W. (2002). Mi'kmaq Treaties on Trial: History, Land, and Donald Marshall Junior. University of Toronto Press. Toronto Ontario. 336 pages.

Williams, M. (1992). Americans and Their Forests: A Historical Geography. Cambridge University Press. Cambridge, England. 624 pages.

Winslow, E. (1783). Letter to Ward Chipman, July 7th, 1783. Winslow Family Papers Volume 2-104 https://web.lib.unb.ca/winslow/partition.html August 12th, 2020.

Wright, E. (1945) The Petitcodiac: A Study of the New Brunswick River and of the People Who Settled Along It. Tribune Press, Sackville, New Brunswick. 72 pages.

Wynn, G. (1981a) Population patterns in pre-confederation New Brunswick. Acadiensis 10(2): 124-137.

Wynn, G. (1981b). Timber Colony: A Historical Geography of Early Nineteenth Century New Brunswick. University of Toronto Press. Toronto Ontario. 224 pages.

Checklist for projects in Atlantic Salmon (*Salmo salar*) habitat

1). Determine if there are any obvious downstream natural or manmade barriers to fish passage (waterfalls, dams, perched culverts, etc) that could prevent salmon from accessing the site.
☐ Done Comment_____

2). If manmade barriers are found, note them for possible future action, or, if practical, consider mitigating them as part of the current project.
☐ Done ☐ Does not apply Comment_____

3). Even where such barriers exist, electrofish or otherwise sample the site to confirm current presence or absence of salmon as part of project planning, prior to any modification of site.
☐ Done Comment_____

4). If no salmon are found and the reason is determined to be a natural barrier, reconsider the need for the project. Perhaps the site should not be considered a priority unless reasons other than promotion of salmon are motivating factors, as resources might be better used elsewhere.
☐ Done ☐ Does not apply Comment_____

5). If no salmon are found at the site but there is no barrier to fish passage (manmade or natural) it is likely that this is a result of the declining population of wild salmon in the region. If salmon are found elsewhere on the river then treat the site as if it has salmon. If no salmon are found in that river then reevaluate the need for the project as resources might be better used elsewhere.
☐ Done ☐ Does not apply Comment_____

6). Plan project thoroughly and allow sufficient lead time to secure necessary permits and schedule work during optimal work conditions. This will help minimize the duration of in stream work, reduce negative impacts, and control costs.
☐ Done Comment_____

7). In sites where salmon are found, observe an operating window of July 1st to September 30th to time any earth moving operations between the end of alevin emergence and the start of spawning.
☐ Done ☐ Does not apply Comment_____

8). In sites where salmon are found, always assume that juveniles and / or migrating adults are present while doing any work during the operating window allowed in item 7. The window indicates reduced sensitivity of fish, not their absence. Care must still be taken to minimize direct harm to fish during work.
☐ Done ☐ Does not apply Comment_____

9). Incorporate erosion and sediment control practices into work plan as laid out in Section 3 of DFO's Land Development guidelines for Protection of Aquatic Habitat (http://www.dfo-mpo.gc.ca/Library/165353.pdf)
☐ Done Comment_____

10). Retain riparian vegetation to protect natural stream conditions and structure and promote stability of the bed and banks. Doing so maintains shade, water temperatures, dissolved oxygen, food supplies, organic debris, cover etc.
☐ Done Comment_____

Checklist for projects in American Eel (*Anguilla rostrata*) habitat

1). Determine if there are any obvious downstream natural or manmade barriers to fish passage (waterfalls, dams, perched culverts, etc) that could prevent eels from accessing the site.
☐ Done Comment_____

2). If manmade barriers are found, note them for possible future action, or, if practical, consider mitigating them as part of the current project.
☐ Done ☐ Does not apply Comment_____

3). Even where such barriers exist, electrofish or otherwise sample the site to confirm current presence or absence of eels as part of project planning, prior to any modification of site.
☐ Done Comment_____

4). Evaluate and estimate quantity and quality of watershed upstream of site for value to eels to better understand and document potential impacts of any gain or loss of access
☐ Done Comment_____

5). Where upstream habitat warrants it, ensure that project design will not create a barrier to eel passage when complete. The best means of maintaining unobstructed passage will be site and project specific, varying significantly between fords, dams, culverts etc.
☐ Done ☐ Does not apply Comment_____

6). If the project site is within 200 meters of the head of tide then time operations for July and August if possible in order to minimize risk of direct harm to elvers migrating upstream (May/June) and eels migrating downstream (September) that could be concentrated and sheltering amid substrates.
☐ Done ☐ Does not apply Comment_____

7). If the project site is more than 200 meters beyond the head of tide then if possible avoid operations during September in order to minimize risk of direct harm to eels migrating downstream that could be concentrated and sheltering amid substrates.
☐ Done ☐ Does not apply Comment_____

8). The primarily way that humans spread the swim bladder nematode (*Anguillicola crassus*) is by moving infected eels into unimpacted watersheds. Most restoration projects pose no risk of this. None the less, understand the nematode's lifecycle, and ensure that the project avoids spreading it.
☐ Done Comment_____

Checklist For Projects in Wood Turtle (*Glyptemys insculpta*) habitat

1). Conduct series of 3 surveys of the site and surroundings at appropriate time of year (spring is best) to determine presence of turtles as part of project planning, prior to any modification of site.
☐ Done Comment_____

2). In addition to looking for individual turtles, assess project site (and surrounding area) to identify turtle nesting sites (best done during nesting season (May/June) the prior year).
☐ Done Comment_____

3). Consider value of site for turtles (if present) relative to other species: stream bank stabilization may benefit salmon, but harm turtles. On a non salmon bearing stream that is home to turtles, taking no action may be the best management.
☐ Done ☐ Does not apply Comment_____

4). Be aware that shortly prior to nesting females concentrate in undisturbed sites adjacent to nest sites, so minimize impacts on the immediate surroundings of nest sites during nesting season.
☐ Done ☐ Does not apply Comment_____

5). If turtles or nest sites are present then plan to conduct restoration activities at both time of year and time of day to try to avoid encounters with turtles.

Time of year	Stage	distance from water	habitat use	most active
Jan/Feb/Mar	hibernating	in pools	in stream	not active
Late Mar/Apr	pre nesting	100 m	aquatic	morning & late afternoon
May /Jun	nesting	3km +	terrestrial	morning & early evening
Jul/ Aug/Sep	post nesting	100 m	aquatic	morning
October	pre hibernation	100 m	aquatic	morning & late afternoon
Nov/Dec	hibernating	in pools	in stream	not active

☐ Done ☐ Does not apply Comment_____

6). If turtles are present, do not stabilize or vegetate any sites that possess ALL of the following characteristics, as these may be nest sites:

a) full sun exposure to afternoon / evening sun (SW aspect)
b) slope less than 40 degrees (nests usually atleast 1.5 m above water surface)
c) sand or sand gravel substrate with little or no ground vegeation (>20% cover)

☐ Done ☐ Does not apply Comment_____

7). If intervention on nesting sites is unavoidable, then mitigate:

- time work either prior to nesting or after hatching (either April or November) if possible, to avoid destroying existing nests
- create compensatory habitat (witch characteristics of item 6: a, b, & c) nearby

☐ Done ☐ Does not apply Comment_____

8). If manipulating project site in turtle habit in July or August and air temps remain over 26° C, search directly affected portions of site for estivating turtles prior to beginning operations.
☐ Done ☐ Does not apply Comment_____

9). Maintain access across finished project site to adjacent suitable nest sites- a low profile wood structure with sod cap is preferable to large rocks or other material that results in slippery surface
☐ Done ☐ Does not apply Comment_____

10) If project has increased human access to site, protect nests with predator exclusion boxes, as human activity increases the density of nest predating species like raccoons and skunks.
☐ Done ☐ Does not apply Comment_____

Checklist for projects in Brook Floater (*Alasmidonta varicosa*) habitat

1). Plan project thoroughly and allow sufficient lead time to carry out necessary site surveys, secure required permits and schedule work during optimal conditions.

☐ Done Comment _____

2) . Compare site to the Petitcodiac map of distribution and abundance of brook floater (https://www.biodiversitylibrary.org/item/108793#page/347/mode/1up) (Hanson and Locke 2001, Canadian Field Naturalist 115(2) 329-340). This habitat lies along the main stem of the Petitcodiac (above the head of tide), and the lower portions of the Little River, and the North River.

☐ Done ☐ Does not apply Comment _____

3). If the site lies within the area identified in #2 then, prior to disturbing it, survey (snorkel or viewing buckets as conditions warrant) to determine if brook floater is present at the site or within 100 metres downstream. Ideal time is June to September (water levels low, turbidity minimal, light penetration best) to allow completion of the work before falling leaves obscure the river bottom in autumn.

☐ Done ☐ Does not apply Comment _____

4). If surveys detect brook floaters at or near the site, then ensure that all subsequent survey work and subsequent long term monitoring (electrofishing, CABIN, etc.) is conducted in a manner consistent with such awareness in order to avoid or minimize impacts on brook floaters.

☐ Done ☐ Does not apply Comment _____

5). If brook floaters detected near site then fording heavy equipment or carrying out in-stream work is problematic. Consult authorities (NB DELG, DFO) as part of WAWA process, and consider alternatives.

☐ Done ☐ Does not apply Comment _____

6). During earthmoving activities with equipment working along the river bank, incorporate erosion and sediment control practices into work plan as laid out in Section 3 of DFO's Land Development guidelines for Protection of Aquatic Habitat (http://www.dfo-mpo.gc.ca/library/165353.pdf)

☐ Done Comment _____

7.) Retain and if possible enhance riparian vegetation, to protect natural stream conditions and promote the structure and stability of the bed and banks. A healthy riparian zone maintains shade, retains sediment, and filters nutrients keeping them out of aquatic ecosystems.

☐ Done Comment _____

8). If cattle are present, measures to protect newly planted vegetation by excluding cattle (i.e. fencing) will also protect brook floaters. Open access to streams by cattle can cause direct mortality to mussels by trampling of mussel beds and lead to habitat degradation through sedimentation and eutrophication.

☐ Done ☐ Does not apply Comment _____