

Fish Habitat Management Plan

Prepared by The *Cornwall and Area Watershed Group*

2025

Fish Habitat Management Plan for the North River and Hyde Creek Watersheds

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1.0 Introduction and Purpose:

The Cornwall and Area Watershed Group (CAWG) has been an active non-profit community group since February 2009. It was founded by a group of Cornwall residents that wanted to play an active role in the conservation and rehabilitation of the Hyde Creek Watershed. In 2013, CAWG's boundaries expanded to encompass the North River Watershed. As part of working goals 4 and 5 from CAWG's 2024 workplan, CAWG is undertaking the design of a fish habitat management plan to help guide efficient and effective action in the rivers they manage. Using data collected from Damage and Vulnerability Assessments, Stream Crossing Assessments, electrofishing, redd surveys, and temperature loggers, this document will analyze the main tributaries in the North River and Hyde Creek watersheds and present management strategies based on these findings.

1.1 Mandate

The Cornwall & Area Watershed Group is a non-profit community group whose goal is to enhance the water quality of our local waterways, to rehabilitate and protect fish and wildlife habitat, and improve outdoor active living through increased recreational opportunities. Our collaborative approach in watershed management integrates residents, farmers, fisherman, municipalities and government to actively work together for a sustainable future in our watershed communities.

1.2 Organizational Objectives

1. Assessment

Collect information through mapping, surveying, assessments, and monitoring programs and evaluate the data to comprehensively understand the present conditions within the North River and Hyde Creek Watershed.

2. Rehabilitation

Initiate projects that will improve the habitat for stream, riparian and upland communities for fish and wildlife.

3. Conservation

Promote best land use strategies and engage in activities that will continue to protect and sustain our natural resources: water, topsoil, trees, and fish.

4. Monitoring

Continue to monitor fish and wildlife populations, stream and upland habitat conditions, and land use practices to be able to evaluate long-term data and broaden our knowledge in understanding what best management practices in both land use and stream rehabilitation make a difference in the sustainability of natural resources within our watershed community.

5. Education

Engage in community events and develop educational programs that promote sustainability and understanding of the environment and the impacts of human activities.

2.0 The Watersheds

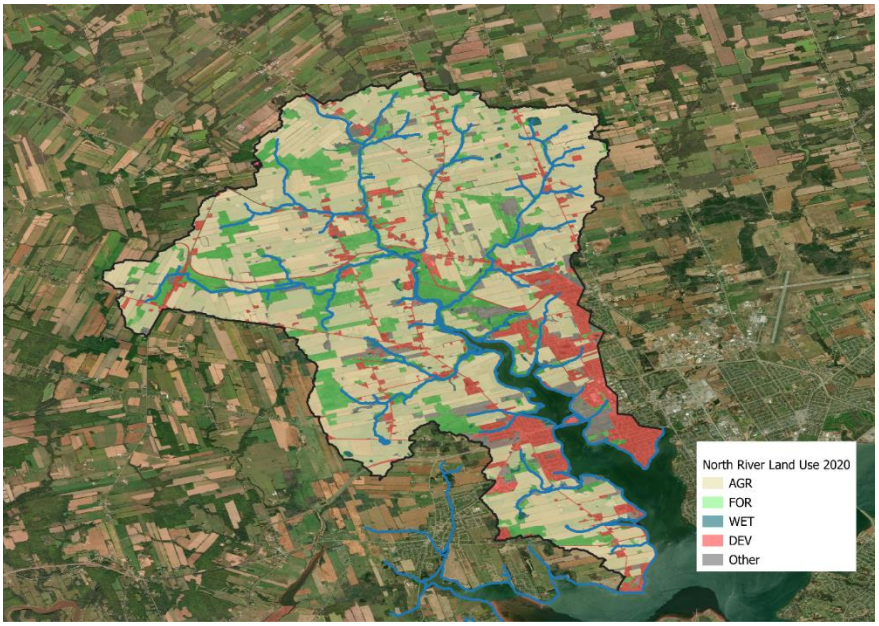
2.1 North River

The North River watershed includes the residents, farmers, fishers, and businesses residing in the communities of East Wiltshire, Milton, North Milton, Miltonvale Park, Warren Grove, Winsloe, North River, and parts of Charlottetown. The North River watershed has a drainage area of approximately 9,695 hectares with 53.7 km of streams. There are seven main tributaries: Warren's Creek, Watts Creek, Coles Creek, Milton Creek, North River North, West and the Main Branch. Land use in the North River watershed can be found below (**Figure 1).**

Figure 1 shows that agriculture is the dominant land use activity in the North River watershed, making up 60.6% of the total area. Forested land accounts for 17.5%, while development (commercial, residential, and urban) covers 20.4% (PEI Department of Environment, Energy and Climate Action, 2020). The land use in the watershed, and the lack of forest cover, contributes to runoff which carries a significant amount of silt and pollution into the North River and its tributaries. As a result of this runoff, water quality is diminished, with the North River watershed receiving a water quality rating of fair in the 2022 Prince Edward Island (PEI) watershed water quality report cards (PEI Department of Environment, Energy and Climate Action, 2022). In extreme cases, runoff from surrounding land can have catastrophic impacts on river ecosystems. In 2014, there was a fish kill on the North River that resulted from agricultural runoff. It is estimated that between 4560-10973 fish were killed in this event (PEI Department of Environment, Energy and Climate Action, 2014).

Figure 1

North River Land Use 2020

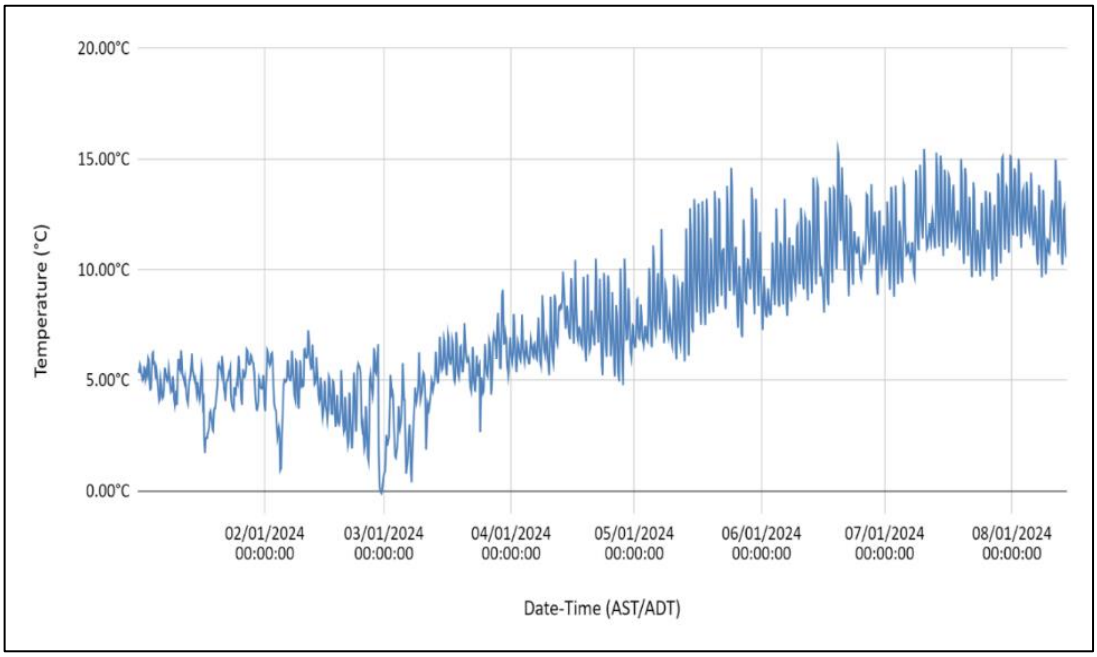


Note. The land use of the North River watershed excluding the areas managed by the Ellen's Creek Watershed Group. Other includes non-developed, institutional, and recreational land uses.

The North River and its tributaries are some of the coldest on PEI, which is a characteristic that benefits fish like Brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo Salar*) that see their growth and survival impacted at higher temperatures (Roloson et al., 2018). Maintaining these cool water temperatures will be important for local fish populations, and potentially for fish populations elsewhere that may seek refuge from rising temperatures in PEI streams. Temperature data for the North River in 2024 is found below **(Figure 2).**

Figure 2

North River Temperatures



Note. Temperature data from January to mid-August 2024. The lowest temperature occurred in March (just below 0°C). The highest temperature occurred in June, when temperatures reached 16.1°C.

The North River has played a significant role in the history of Cornwall. The river has provided mud and fertile soil for agriculture, supported a shipbuilding industry, and fostered shellfish for fisheries, three essential industries to the town of Cornwall's economic development (Richards, n.d.). While the North River is no longer central to our way of life, key aspects of our

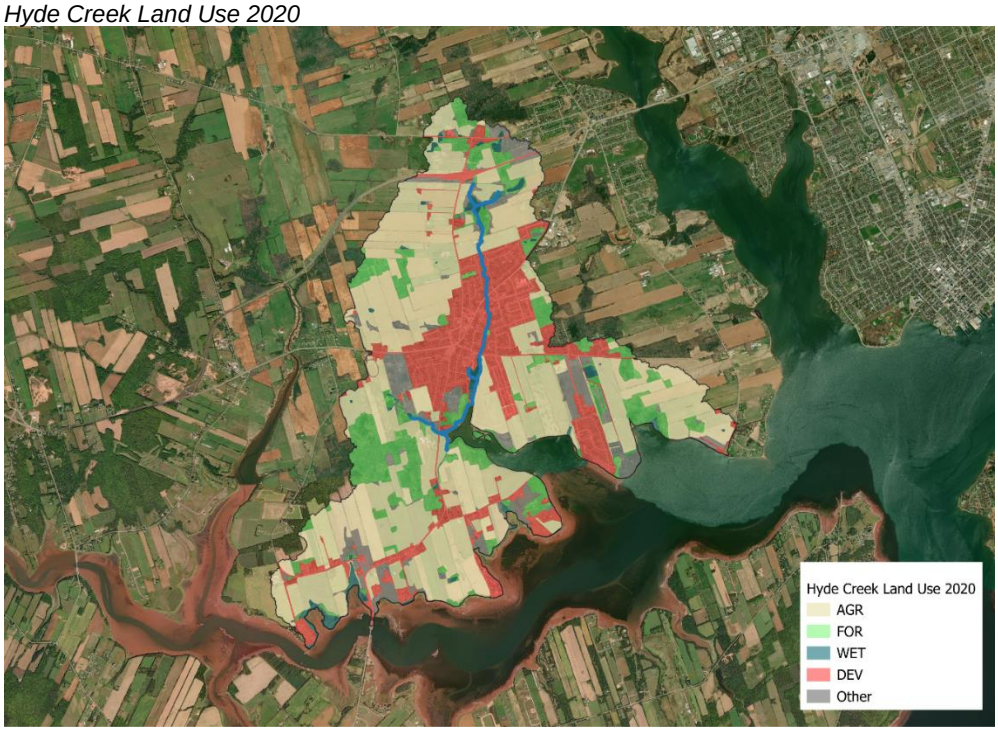
health and well-being can be tied to keeping our environment healthy. This connection allows CAWG to improve the North River watershed while benefiting our communities.

2.2 Hyde Creek

The Hyde Creek watershed includes the residents, farmers, fishers, and businesses residing in the Town of Cornwall. It is a sub watershed of the West River but is managed by CAWG. The Hyde Creek watershed has a drainage area of approximately 2,009 hectares with 5.9 km of stream. The main tributary is Hyde Creek, a stream that runs through Cornwall. Over the years, Hyde Creek has supported shipbuilding, recreational fishing, ice skating, agriculture, and a mill. Hyde pond, which was once home to a prominent mill in the area, has been a mainstay in the lives of many Cornwall residents for generations (Richards, n.d.). The Hyde Creek watersheds shape and land use is displayed below (**Figure 3).**

Figure 3

Hyde Creek Land Use 2020



Note. The land use of the Hyde Creek watershed. The Hyde Creek, marked by the blue stream outline, runs through the most densely developed and populated area of the watershed. Other includes non-developed, institutional, and recreational land uses.

Figure 3 shows that the Hyde Creek watershed has both urban and rural characteristics. 63.4% of land use is agriculture, 20.0% is developed, and only 14.6% is forested (PEI Department of Environment, Energy and Climate Action, 2020). As you can see from the map, development is highly concentrated along Hyde Creek. The combination of asphalt, building foundations, and highly compacted soil significantly increases the rate of runoff during precipitation events. Since there is also a lot of agricultural land, silt, nitrates, salt, and other pollutants are regularly carried into Hyde Creek from runoff. As a result of these inputs, the water quality in Hyde Creek is considered fair (PEI Department of Environment, Energy and Climate Action, 2022). Similarly to the North River, water pollution has had catastrophic consequences in the past. In 2017, Hyde Creek experienced a fish kill caused by pesticide runoff. 120 dead fish, mostly Brook trout, were recovered, but many more likely perished (McEachern, 2018). After the fish kill, Hyde Creek was closed to angling until 2020 and was stocked with 900 Brook trout in 2019 (MacDonald, 2019).

With a combination of urban and rural pressures, the Hyde Creek watershed's trajectory in terms of environmental health is challenged by continued population growth, urban development, soil erosion, and climate change. Our fieldwork, including planting riparian vegetation, installing fish habitat structures, and cleaning litter from the creek, is vital in addressing these threats and restoring Hyde Creek's natural health. Additionally, protecting Hyde Creek involves creating public spaces that foster environmental stewardship, such as the naturalization gallery, and collaborating with farmers. Both community support and restoration efforts are essential for the long-term health of the Hyde Creek watershed.

3.0 Present Fisheries Resources

The populations of fish in the North River vary from salmonids like the brook trout (*Salvelinus fontinalis*), the Atlantic salmon (*Salmo salar*), and the non-native rainbow trout (*Oncorhynchus mykiss*), to smaller fish such as sticklebacks (*Gasterosteidae sp*), mummichogs (*Fundulus heteroclitus*), and red bellied dace (*Chrosomus eos)*. Gaspereau (*Alosa pseudoharengus*) and rainbow smelts (*Osmerus* mordax) are observed migrating upstream in the spring. Analysis of electrofishing data from 2021-2023 found an increase in total salmonid density across all tributaries although changes in survey methods may have impacted these numbers. This change was a result of an increased count of rainbow and brook trout, with salmon density decreasing over that same period. Atlantic salmon have not been found during electrofishing surveys since 2022. The increase in rainbow trout population, the potential competition between rainbow trout and Atlantic salmon for habitat, and the decline in observed salmon populations are all concerns that must be weighed heavily in management decisions regarding fish habitat going forward. Atlantic salmon are not present in Hyde Creek, and smelts have not been observed migrating on the creek recently. The species composition varies above and below Hyde Pond. Above the pond, you will find more salmonids (brook trout, rainbow trout). Below the pond, the species composition is mostly mummichogs and sticklebacks.

4.0 Monitoring

4.1 Electrofishing

Annually, the Department of Forest, Fish, and Wildlife have performed electrofishing at 3 index sites within the North River watershed. The goal of using annual electrofishing is to identify the species composition of a reach, confirm juvenile Salmon habitat and estimate population density. CAWG has conducted its own yearly electrofishing surveys to monitor fish

populations since 2021. In the first two years of surveying, a total of 17 index sites were surveyed on the North River Main Branch, North River North Branch, Watts Creek, and Milton Creek. Due to a reduction in crew size and reduced equipment availability, only five index sites and 3 spot check sites were surveyed in 2023. Two of the spot check sites were on Hyde creek, one below the pond and the other above. In 2024 there were six index sites and 2 spot check sites. Three surveys were conducted on Watts and three on the Main Branch of the North River. One spot check was conducted on lower Coles, and the other on Hyde Creek above the pond.

4.2 Temp Loggers

In 2019, CAWG placed temperature loggers on North River and Watts Creek to monitor whether temperatures were too cold for salmon to feed after they hatched. In 2021, two more temperature loggers were placed on Coles Creek. It was found that temperatures in the North River watershed were not too cold for salmon to feed during the time of emergence, but that monitoring should continue moving forward. As of 2024, the only active logger is found on North River. This is due to post-tropical storm Fiona which occurred in 2022. There are plans to place more temperature loggers to build a baseline of day-to-day river conditions.

Redd Surveys

Table 1 showcases CAWG's salmon redd counts. Data from these surveys begins in 2008, although detailed data and reporting goes back to only 2016. Redd surveys are conducted between mid-November and late-December annually and are primarily conducted to detect the

Table 1

Redd Survev Data 2008 - 2024

Year/# of Redds	2008	2011	2013	2016	2017	2018	2019	2020	2021	2022	2023	2024
North River	18	11	21	3	8	1	5	0	7	2	0	3
Watts Creek	*	*	*	0	1	5	5	2	5	5	0	7
Coles Creek	*	*	*	1	0	0	2	1	*	0	0	2

Note. Atlantic salmon redd counts for tributaries containing salmon. *Surveys not completed due to extenuating circumstances.

presence of Atlantic salmon spawning. For that reason, tributaries that are historically inhabited by salmon (Watts, Coles, and North River) are prioritized. From 2016-2023, target reaches would be walked only once per survey period. However, in 2024 CAWG redesigned these survey methods to include periodic visits to survey reaches over the spawning season based on recommendations from Trout Unlimited's Redd Survey Handbook (2020).

5.0 Threats to Fish Habitat

5.1 Siltation and Pollution

Siltation is often considered the biggest threat to salmonids on PEI. Siltation occurs when small particles like silt and sand enter a stream from bank erosion or surrounding land. The fine particles then cover over the stream bed, eliminating important stream bottom habitats. Throughout their lives, salmonids rely on the stream bottom in a multitude of ways, all of which are impacted when silt and fine particles cover larger substrate types. Salmonids lay their eggs in riverbed nests (redds) that facilitate the delivery of well oxygenated water to the eggs and resist being carried away during flood events. The best substrate for this purpose is gravel and cobble, which are small enough for the salmonids to move with their bodies during redd creation, but also large enough to resist scouring during floods (Riebe et al., 2014). Due to its larger size, the piled gravel and cobble creates interstitial spaces between the particles, which stream water can flow through to deliver oxygen and carry away waste (Guignion et al., 2010). When silt covers spawning substrate, it can cement gravel and cobble, making it unusable for spawning. When silt covers an already constructed redd, the spaces between the rock particles become filled, suffocating the eggs before they have the chance to hatch. However, the impacts of siltation go far beyond spawning. Juveniles, and even adults, will also utilize these interstitial spaces as cover from predators or refuge from warm temperatures. As a result, a coarse (large rocked)

streambed can support a higher number of individuals compared to a homogenous streambed with no interstitial spaces for cover. Another factor that can affect growth and habitat quality is the available dietary items. Ideal dietary items are benthic macroinvertebrates, such as mayflies and stoneflies, which usually thrive in high quality habitat with rocky streambeds opposed to silt dominated streams, which typically contain lower quality food items (midges, worms, etc.) (Raleigh, 1982).

Silt runoff enters the stream from a range of sources, the main sources being roads and agricultural fields. The sources of this silt create an additional problem, water pollution. In addition to small particles that cover habitat, runoff also carries f. ilizers, pesticides, road salts, and other pollutants into the watercourse. Certain pollutants, like pesticides, not only degrade water quality but can also bioaccumulate in the food chain, where they gradually build up in the tissues of organisms. As predators consume contaminated prey, the concentration of pollutants in the organism increases, leading to long-term health impacts on populations of fish, birds, other wildlife, and potentially humans (Ray & Shaju, 2023). Other pollutants, like fertilizers from agricultural fields, can decrease dissolved oxygen by promoting the growth of oxygen consuming bacteria, exacerbating an issue caused by small, suspended sediment particles in the channel (Juncal et al., 2023).

CAWG has been actively working with local landowners and various government departments to address runoff at the source. Restoration work compliments this strategy. Improving buffer zones, trapping sediment, and removing blockages are some strategies employed by CAWG to reduce in-stream sediment and pollutants.

5.2 Fish Kills

A fish kill is an event in which a large number of fish die in a short period of time due to natural, or human-caused, environmental stresses. Some causes of fish kills include algal blooms, extreme temperatures, and chemicals entering the water. Recovery from these events can span years, or decades depending on the magnitude of the disturbance and other subsequent disturbances (Rohr et al., 2021). On PEI, there have been over 50 fish kills proven or suspected to be caused by pesticides since 1962. Most of these fish kills occurred in July and August, although some have been reported in June, September, and October. Pesticide induced fish kills almost always happen after heavy rain washes pesticides into water ways, however improper cleaning of equipment, or accidental discharge of pollutants, can also lead to fish kills (PEI Department of Environment, Energy and Climate Action, 2020a).

There have been four recorded fish kills on the rivers managed by CAWG since 1967: in 1967, 2002, and 2014 on the North River, and in 2017 on Hyde Creek. Fish kill events devastate local fish populations, potentially killing hundreds, if not thousands of fish. The 2014 North River fish kill was estimated to have killed between between 4560-10973 salmonids, most of which were brook trout although rainbow trout and Atlantic salmon were also recovered in high numbers relative to their populations (PEI Department of Environment, Energy and Climate Action. (2020b). The long-term implications of such deadly events are not well studied, but the loss of genetic diversity undoubtedly affects the ability of populations to adapt to other environmental stresses for years to come (Guignion et al., 2010).

The risk of pesticide-induced fish kill events is likely to increase because of climate change. Rising temperatures, more severe heavy rainfall events, and changes in seasonal weather patterns can exacerbate pesticide runoff into waterways. To combat this risk, agricultural

practices such as reducing pesticide use, and improving the timing, and method of pesticide application are crucial. Watershed management efforts can also help reduce the risk of fish kills. By ensuring buffer zones are healthy, a portion of pesticide runoff can be stopped before it enters the stream. However, no amount of buffer zones can prevent a fish kill without strategic pesticide application.

5.3 Climate Change

Climate refers to the average weather conditions, primarily temperature and precipitation, experienced over an extended period. Over the last 50 years, annual ambient temperature in Central PEI has increased by 0.7 °C while average annual precipitation has fallen by 5% (Bhatti et al., 2021). Projections suggest a possible temperature increase of 2.42°C-2.56°C and a 5% rise in precipitation by 2050 (Bhatti et al., 2022).

Two broad ways of looking at climate impacts are day-to-day impacts and changes in extreme event frequency and severity. Day-to-day impacts are shifts in average conditions and are likely to be gradual. For example, average water temperature is a crucial day-to-day habitat variable that will be impacted by climate change. While PEI's rivers are primarily fed by groundwater, creating stable year-round temperatures, certain river sections, like lower-Coles creek, may eventually experience average weekly temperature levels that are outside optimal growth conditions for salmonids in the warmer months (Van den Heuvel et al., 2021). Changes in average conditions can also alter the timing and magnitude of important environmental events. For instance, a model by Bhatti et al. (2022) projected average monthly temperatures reaching above freezing in March rather than in April by 2050. A change like this could result in more late winter rainfall events, increasing the likelihood of super cooling events that kill incubating salmonids (Guignion et al., 2019). In addition to temperature, average stream flow is also

projected to be impacted by climate change. Bhatti et al. (2022) includes a general model on stream flow and groundwater recharge in Central PEI that is based on data from the West and Winter Rivers. In this model, stream flow is forecasted to decrease overall. However, there is a considerable lack of understanding surrounding changes in stream flow due to climate change on PEI (Cairns et al., 2023).

Extreme events take the form of intense precipitation, floods, post-tropical storms, heatwaves, and droughts. While changes in the rate of occurrence for these events is debated, the increased intensity of extreme events due to climate change is typically agreed upon (Arnold and Fenech, 2017; Bhatti et al., 2022). A notable example of an extreme event having dire consequences for stream ecosystems was when post-tropical storm Fiona struck PEI in 2022. The storm brought strong wind gusts of 133km/h and heavy sustained rainfall totaling 86.2mm to Charlottetown, devastating local infrastructure, levelling trees, and causing rivers to flood (CBC News, 2022). The storm caused a significant influx of silt into PEI streams and a sharp reduction in canopy cover, impacts that are still being felt by stream ecosystems. While climate change did not directly cause the storm, warmer ocean temperatures allowed Fiona to maintain its strength as it approached Atlantic Canada (Snoddon, 2023). The devastation of Fiona showcased how vulnerable we are to intensifying storms and the need to improve our resilience. In addition to hurricane-like storms, extreme events can also be periods of high temperatures and low precipitation. Prolonged droughts can cause even the most resilient ecosystems to experience highly stressful conditions. During 2020, there were drought-like conditions experienced in Central PEI resulting in low water levels during the spawning season. In that year, CAWG did not find salmon redds up any major tributary and redds were found in abnormal areas. As a

result, eggs were placed in lower-quality habitat, potentially impacting their survival to emergence.

5.4 Barriers to Passage

Barriers to fish passage are obstacles that can impede or completely block fish from accessing habitats. Unlike terrestrial ecosystems, where animals can often find alternative routes, streams typically have a single path, meaning barriers can completely block fish from accessing habitat. Barriers to passage can be especially problematic to migratory species like Atlantic salmon, who may be blocked from accessing spawning grounds at the end of an exhausting journey. Since barriers to passage can become more or less impassible depending on environmental conditions like water levels, fish migrations often align with environmental factors that correspond with the most passable conditions (Thorstad et al., 2011). There is fear that climate change, which is causing a shift in the timing, duration, and magnitude of favourable environmental conditions, will cause migrations to become misaligned with passable conditions (Thorstad et al., 2021). On top of problems for long migrations, barriers can also cause problems for fish seeking refuge in response to environmental extremes, blocking them from accessing more suitable habitat during extreme heat or droughts.

On PEI, beaver dams are known to create barriers to fish passage in some watersheds. However, their low density in the North River and Hyde Creek watersheds makes them a less pressing concern compared to other types of barriers. More significant issues arise from culverts and impoundments. Problems like hung culverts, low water levels, and water velocity can prevent salmonids from accessing important headwater areas. Impoundments, on the other hand, can raise water temperatures and contribute to algal blooms, leading to anoxic conditions that are detrimental to fish survival. This is of particular concern in areas like Coles and Milton Creeks,

where numerous impoundments disrupt the natural temperature regime of the streams. Efforts to address these barriers are ongoing. For example, in 2024, the Hyde Pond spillway was redesigned to improve fish passage. Currently, planning is underway to address a problematic culvert on Loyalist Road.

5.5 Introduced Species

Rainbow trout can be found throughout the entire North River watershed and have been an ongoing problem for decades. Due to their hardiness in degraded habitats, rainbow trout were intentionally introduced as a sport fish in the 20th century (Roloson et al., 2018). The traits that made rainbows ideal candidates to support angling when native salmonid populations were declining are also the traits that make them problematic invaders. Rainbow trout tolerate warmer temperatures than native salmonids, grow faster, require less egg incubation time (limits the impact of sedimentation), and have been shown to recover more rapidly from toxic runoff events (Viant et al., 2003; Gormley, 2005; Chadwick and McCormick, 2017; Roloson et al., 2018; Van den Heuvel et al., 2021). These traits help rainbows thrive in areas dominated by agriculture and human development, two of the dominant land uses in the watersheds managed by CAWG (PEI Department of Environment, Energy and Climate Action, 2020b; Roloson et al., 2018; Van den Heuvel et al., 2021). In addition to better tolerating habitat degradation, inter specific competition for spawning area, food, and cover are also potential issues for native salmonid populations (Thibault & Dodson, 2013).

While the competitive interactions between Atlantic Salmon, brook trout, and rainbow trout have implications for conservation, and there is literature that showcases a potential for concern, the most accepted view on PEI is that the abundance of high-quality habitat is likely the more critical factor when trying to manage habitat for native salmonids (Roloson et al., 2018;

Cairns et al., 2024). However, given the status of Atlantic salmon populations in the North River system, redd superimposition is worth investigating. While brook trout and salmon both spawn in late autumn, rainbow trout spawn in April. Rainbow trout are known to superimpose redds over Atlantic salmon spawning areas, this has been observed on the West River (Guignion et al., 2019). When superimposition happens, survival to emergence can be heavily impacted. Monitoring this potential occurrence will be done through rainbow trout redd surveys on any installed spawning structure where potential salmon redds have been identified.

6.0 Strategies for Fish Management

6.1 General Strategies

6.1.1 Community Involvement

Watershed management presents challenges but also opportunities for collaboration. To help foster collaboration, CAWG is working towards establishing an identity as a force for environmental conservation in all communities within the North River and Hyde Creek watersheds. To help in achieving this goal, CAWG hosts several yearly events aimed at inspiring community collaboration on environmental conservation. Of these events, the Bass fishing derby was an overwhelming success that brought the community together to share in a passion for fishing and the outdoors. CAWG recognizes the connection between a community engaged with nature and a healthy environment, and seeks to give community members opportunities to develop, build, and solidify their own relationships with the natural world. Community awareness is especially important for Hyde Creek, which runs through the most densely populated portion of the Town of Cornwall, a rapidly growing municipality with strong roots in agriculture and outdoor recreation.

6.1.2 DVAs

To help identify where fish habitat management is most needed, CAWG undertook Damage and Vulnerability Assessments (DVAs) that were completed during the 2024 field season. The assessments split tributaries into multiple reaches, which were then scored on performance in various categories including buffer zone health, in-stream habitat, sedimentation, and potential barriers to passage. The results of these surveys were used to create GIS maps. The maps were designed to pinpoint areas that require attention or restoration and will help guide decision making. For example, areas shown to have high sedimentation and many potential blockages can be prioritized for woody material management. CAWG will work to fill in any missing data points on DVAs. Subsequent assessments will be completed periodically to monitor changes. For DVAs, reassessment every 3-5 years is recommended. CAWG will ensure that staff receive training and are comfortable with the surveys prior to conducting them to guarantee reliable results.

6.1.3 Stream Crossing Assessments

CAWG will continue to inventory culverts and will continually work to restore stream connectivity throughout all streams. To aid in this goal, CAWG will work with landowners to secure funding to address problematic culverts on private road crossings. In addition to private road crossings, CAWG will continue to collaborate with government organizations to address problematic culverts on public roads. Planning is currently underway to address the Loyalist Road culvert on Watts creek to help restore year-round fish passage to the sections upstream of the culvert.

6.1.4 Identify and Address Sources of Runoff

CAWG has begun identifying areas of sediment input from surrounding land uses. To help identify sources of runoff, CAWG will conduct runoff surveys during rain events. Using field mapping applications, any problematic sources of runoff observed by workers during the field season will have GPS data recorded and stored for future visitation.

6.1.5 Restore In-Stream Cover and Habitat Diversity

To restore in-stream cover and habitat diversity, CAWG will expand buffer zones, install brush mats, construct in-stream rock shelters, and install instream woody material with consultation from experts and with guidance from the Technical Manual for Watershed Management on PEI (2012). With in-stream cover and habitat diversity in mind, woody material management will be undertaken according to CAWG's woody material management plan, and with consultation from experts in hydrology, fluvial geomorphology, biology, and with relevant stakeholders.

6.1.6 Monitor Stream Temperatures

To monitor the impacts of climate change on stream conditions, CAWG will work to expand temperature monitoring in the major tributaries of the North River and Hyde Creek watersheds. Monitoring temperature is essential to detecting changes in the living conditions experienced by salmonids in our streams. Having temperature monitoring in place can also help determine the extent to which extreme events are impacting streams. For instance, if there is a drought or a heatwave, water temperature monitoring can be used to determine if temperatures are reaching a point that could be detrimental to fish, and where these conditions are taking place. This information can then be used to guide restoration work aimed at improving the climate resilience of our streams.

6.1.7 Continue Obtaining Landowner Permission

CAWG has sought landowner permission to gain access to sites for assessment and restoration. Landowner permission forms also ask respondents whether they are open to trail creation and tree planting on their property. When necessary, and given landowner permission, trails will be carefully constructed to ensure easier access for management work. When given permission, riparian tree plantings will be undertaken in areas found to need buffer zone expansion or diversification, with the goal of having healthy buffer zones that provide shade, woody material, and nutrient input while protecting fish habitat from flooding, bank destabilization, runoff, climate change, and pollution.

6.1.8 Expand Buffer Zones Where Possible

CAWG will continue to plant trees and expand buffer zones, with the goal of having at least 2 layers of vegetation where possible, as this is one of the most effective ways to improve the overall health of any river system. The literature demonstrates the positive impact of forest health on native salmonid populations and highlights a possible relationship between deforested, high agricultural land use watersheds and rainbow trout success (Roloson et al., 2018; Guignion et al., 2019; van den Heuvel et al., 2021; Cairns et al., 2023). CAWG will prioritize survival when planting, with the hopes of creating seed sources that contribute to a healthier watershed for generations. Planting for survival starts with site assessment and selecting species that are able to tolerate conditions at the planting site. After trees are planted CAWG will monitor plantings and preform maintenance annually. While tree planting is given as a general strategy, specific areas that would benefit greatly from more tree cover and expanded buffer zones are explored in the specific strategies section below.

6.1.9 Partner with Farmers on Soil Conservation Projects

CAWG has been successfully collaborating with landowners on soil conservation projects with help from the PEI Department of Agriculture and the PEI AgriWatershed Partnership. Through these partnerships, both farmers and river ecosystems benefit. CAWG will continue working with farmers adjacent to waterways and will share these successes on social media to inform potentially interested landowners and the community about ongoing conservation efforts.

6.1.10 Monitoring Past, Current, and Future Projects

Monitoring is an essential part of stream restoration work. Monitoring not only measures project effectiveness but also helps us adjust to unforeseen challenges and share our findings with community members, experts, and project funders. When a project calls for monitoring, and consistent guidelines have not already been established, CAWG will work with experts and consult the scientific literature to develop monitoring protocols. Developing protocols will also involve establishing how the data will be analyzed, how often it will be collected, and where it will be stored. When deemed necessary, pre-monitoring for projects will be undertaken to establish a baseline of conditions before the restoration work. CAWG will ensure that staff receive training in the established data collection techniques to guarantee reliable results.

6.2 Specific Strategies

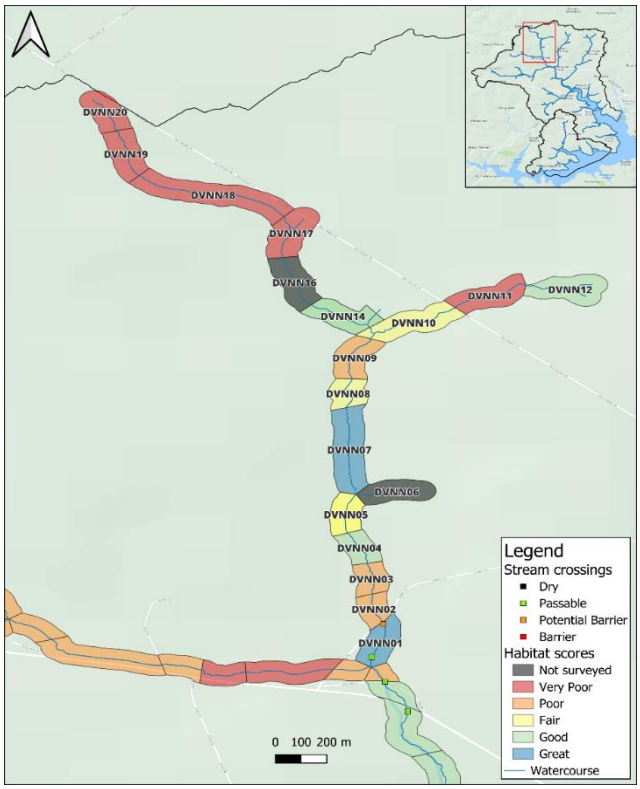
6.2.1 North River North Branch

The North River North Branch's headwaters are near the New Glasgow Road. The mouth is just below Crabbe Road, where the North Branch combines with the West Branch. Land use around the North Branch is heavily dominated by agriculture and development, with the New Glasgow Road running adjacent to the headwaters. UPEI has a flow monitoring station below the

mouth of this tributary. This monitoring station will be considered, and the researchers will be contacted before any work is done that could cause large disturbances to these flow measurements. **Figure 4** shows the DVA results on North River North

Figure 4

North River North Branch Habitat Score Map



Note. DVA data for North River North showing salmonid habitat scores and stream crossings. Salmonid habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. Each reach is assigned a score from 0-30 based on performance in these categories. Habitat score ranges are as follows: very poor (0-7 points), poor (8-12 points), fair (13-17 points), good (18-22 points) and great (23-30 points). Stream crossings are classified as passable, potential barrier, or barrier.

Table 2

North River North Branch DVA Summary

Reach ID	% of Silt	Barriers
DVNN01	25-50%	0
DVNN02	50-75%	1-2
DVNN03	50-75%	1-2
DVNN04	25-50%	1-2
DVNN05	50-75%	1-2
DVNN06	*	*
DVNN07	25-50%	1-2
DVNN08	25-50%	1-2
DVNN09	75%+	1-2
DVNN10	25-50%	3+
DVNN11	75%+	3+
DVNN12	25-50%	3+
DVNN13	Dry	Dry
DVNN14	50-75%	0
DVNN15	Dry	Dry
DVNN16	*	*
DVNN17	75%+	1-2
DVNN18	75%+	1-2
DVNN19	75%+	1-2
DVNN20	75%+	1-2

Note. Supplemental DVA data for North River North. The barriers section does not include stream crossings and should be understood as potential barriers from blow down in the channel. * indicates that the survey was not completed due to extenuating circumstances. Dry indicates the reach was unable to be surveyed because the stream was dried up.

A significant weakness of North River North is the lack of a forested buffer at the headwaters. The headwaters also have several areas where fields extend into the buffer zone giving soil erosion a quick and easy path into the stream. As a result of unmaintained buffer

zones, a lack of trees, and the presence of gullies, the North Branch's headwaters are heavily silted (See DVNN17-20 in **Table 2**). In the future, efforts will be undertaken to expand buffer zones and address sediment input sites at the headwaters. Central to these efforts is the need to establish positive working relationships between CAWG and landowners. Landowners at the headwaters will be contacted about tree plantings with the hopes of fostering collaboration. CAWG will encourage landowners to pursue soil conservation projects and will help landowners secure funding for these projects. In the event collaboration is unable to be established, Shawn Schofield Ag-environment team leader, will be contacted to help ensure reliance with regulations. To help better understand sources of silt at the headwaters, a visit will be made to assess DVNN16 (Unassessed reach in **Figure 4**). During this visit, the headwaters will be walked to identify potential sources of runoff from surrounding land. Areas where the regulated buffer zone is not being observed will also be noted, and the landowners contacted about establishing collaboration on addressing these problematic areas.

6.2.1.1 Strategies

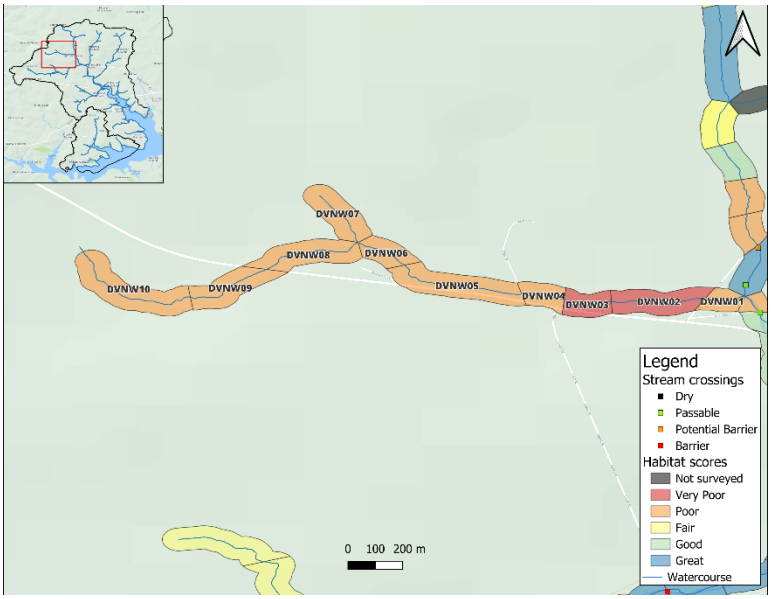
- Complete missing DVA at the headwaters (DVNN16), using this as an opportunity to visit upper reaches and document areas of problematic runoff from surrounding land, and areas where the 15m buffer zone is not being maintained. Contact landowners about the potential to collaborate on these issues.
- Directly contact landowners near the headwaters who have not responded to landowner permission forms about planting vegetation in buffer zones.
- Build collaborative relationships with landowners through tree plantings and partnerships on soil conservation projects to protect reaches downstream.

6.2.2 North River West Branch

The North River West Branch has headwaters near the Route 2 highway. The West Branch's mouth is where the tributary combines with the North Branch. Land use around the West Branch is heavily dominated by agriculture and development, with the route 2 highway running adjacent to the tributary. **Figure 5** showcases the results of DVAs on North River West.

Figure 5

North River West Branch Habitat Score Map



Note. DVA data for North River West displaying salmonid habitat scores based on substrate composition, shade, barriers to passage, presence of pools and springs, and available cover types. Habitat scores in this tributary range from very poor (0–7 points) to poor (8–12 points).

Table 3

North River West Branch DVA Summary

Reach ID	% of Silt	Barriers
DVNW01	75%+	1-2
DVNW02	75%+	3+
DVNW03	75%+	3+
DVNW04	75%+	1-2
DVNW05	75%+	0
DVNW06	75%+	3+
DVNW07	75%+	3+
DVNW08	75%+	3+
DVNW09	75%+	3+
DVNW10	75%+	3+

Note. Supplemental DVA data for North River West. The barriers section does not include stream crossings and should be understood as potential barriers from blow down in the channel.

From the results of the DVAs, the West Branch is one of the most silted tributaries in the entire North River watershed. All 10 reaches had greater than 75% silt and fines in the substrate (**Table 3**). Evidently, siltation is a major limiting factor for salmonids in this tributary. Two of the primary sources of this silt are soil erosion from fields, and bank erosion. Much like the North Branch, there are several areas where the 15m regulated buffer zone is not maintained, and fields extend into the buffer zone. To address this, CAWG will continue building relationships

with landowners to cooperate on limiting silt inputs from surrounding land. A similar approach will be taken here as on the North Branch, aiming for positive collaboration, with the goal of helping landowners conserve their soil and comply with regulations while protecting the river. In the event collaboration is unable to be established, Shawn Schofield Ag-environment team leader, will be contacted to help ensure reliance with regulations. In terms of bank erosion, there are several areas where banks are on the verge of collapsing, and intervention is needed to prevent banks from being pulled into the channel. In these areas, consultation with experts in relevant fields will be undertaken to establish strategies to prevent bank failure, and banks will be reinforced with willow stakes. While siltation is by far the largest issue, the West Branch also scored poorly in terms of connectivity. While culvert assessments on this tributary are absent, only one of the ten reaches was deemed free of potential blockages during DVAs. Given the presence of instream obstructions and the large amount of fine sediment, woody material management in accordance with the woody management plan will be conducted on this tributary.

6.2.2.1 Strategies

- Directly contact landowners to facilitate cooperation and gain permission to plant trees and address gullies at the headwaters.
- Take coordinates of gullies and areas of potential bank failure so these areas can be located again when expert opinions are sought.
- Use willow stakes to reinforce banks that are susceptible to failure.
- Conduct Stream Crossing Assessment on Crabbe Road culvert.
- Build collaborative relationships with landowners through tree plantings and partnerships on soil conservation projects.

6.2.3 North River Main branch

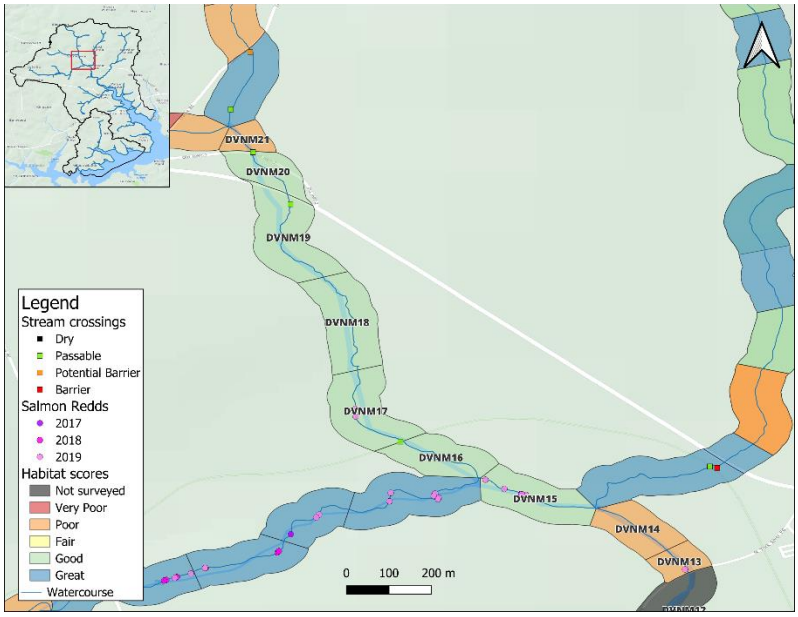
The North River main branch begins where the North and West Branches meet. The mouth is found where the river enters the Charlottetown Harbor. Three sections that vary in habitat quality and buffer zone composition occur along the Main branch. The first is a small section stretching from the top to the Route 2 culvert ("Route 2 area" DVNM20-21 in **Figure 6**). The Route 2 area has a mostly grass buffer with high levels of in-stream sediment and a deeply incised channel. The second section ("above the forks" DVNM16-19) stretches from below the route 2 culvert to the Watts creek and North River forks (where Watts Creek and North River meet is colloquially referred to as the "forks"). This section has much more habitat diversity, a mature, forested buffer, and less in-stream silt and fines. The last section, found below the forks (DVNM15 and below), is mostly tidal, acting as a buffer for sea-run fish where they acclimate to fresh water (below the forks). Buffer zone composition in this section is primarily grasses and shrubs (alder, choke cherry), with the river following a mostly straight path. A rock deflector was installed to help restore the meander, but additional work is still needed to create flow diversity in this section. While primarily a migration corridor, some spawning does occur below the forks. In 2024, a potential salmon redd and multiple brook trout redds were observed at the tail of the forks pool during redd surveys. Other potential spawning areas exist further downstream, but no spawning has been observed in these areas since 2019 possibly due to a lack of suitable substrate and high fine sediment levels. **Figure 6** shows DVA reaches and the three sections of the Main Branch.

The Route 2 area is heavily silted and deeply incised (see **Table 4)**. On DVNM21, a portion of the right bank has a hedgerow with bank erosion that is pulling the hedgerow into the stream. There are no other trees in the riparian area, and the buffer zone is not maintained. The

Landowners have indicated they are potentially open to tree plantings and will be contacted about expanding the buffer zone on their property. To address channel incision, woody material will be added to the stream to slow down water flow. Since DVNM20 already has a considerable amount of woody material, these efforts will be focused in DVNM21.

Figure 6

North River Main Branch Habitat Score Map



Note. DVA data for the North River Main Branch displaying salmonid habitat scores based on substrate composition, shade, barriers to passage, presence of pools and springs, and available cover types. Habitat scores in this tributary are either poor (8–12 points) or good (18-22 points). There are three distinct areas as indicated in the paragraph above. The Route 2 area (DVNM20-21), above the forks (DVNM16-19), and below the forks (DVNM15 and below).

Table 4

North River Main Branch DVA Summary

Reach ID	% of Silt	Barriers
DVNM13	75%+	0
DVNM14	75%+	0
DVNM15	50-75%	0
DVNM16	50-75%	1-2
DVNM17	25-50%	1-2
DVNM18	25-50%	1-2
DVNM19	25-50%	1-2
DVNM20	75%+	0
DVNM21	75%+	0

Note. Supplemental DVA data for the North River Main Branch. The barriers section does not include stream crossings and should be understood as potential barriers from blow down in the channel. Reaches below 13 were not assessed due to their incompatibility with the metrics used to assign scores in DVAs.

The section above the forks contains many salmon spawning areas with large substrate (DVNM16-19 in **Figure 6**). Sediment levels above the forks are mostly between 25-50% of the total substrate, which is high enough to cause problems for spawning, rearing, and productivity in some areas, but is still below average for the watershed. To make sure salmon can utilize this spawning and rearing substrate, CAWG conducts raking and rock flipping on this section of the Main Branch yearly. These activities will continue moving forward. At the top of the section is

the Route 2 culvert pool. The pool is deep, and is frequented by many salmonids, but there are concerns surrounding the lack of cover in the area. Previous attempts to introduce cover with cover logs were unsuccessful and led to unintended consequences that resulted in the cover logs being removed. Moving forward, CAWG will look to develop alternative strategies to introduce cover into this pool area.

The section below the forks acts as both a migration corridor and habitat for resident and sea-run fish. Just below the forks is the forks pool, an important area for salmonids and recreational observers alike. Over time, the forks pool has been filling in with silt from sources upstream. CAWG's work upstream has been reducing the amount of sediment entering the pool, but work is still needed to clear out the silt that has settled. To address this siltation, CAWG will consult with relevant experts to develop strategies to scour out the pool. Downstream, there are several cobble and gravel riffles currently used for spawning, as well as potential areas for spawning that will be restored with the addition of adequately sized substrate, and spawning structures. CAWG will seek guidance from relevant experts on the placement, design, maintenance, and skills needed to create effective spawning structures.

Below the potential spawning areas, is the migration route where siltation is high, and hydrological diversity is low. The lack of hydrological diversity is concerning, especially for migratory fish that benefit greatly from resting pools as they near the end of their long journey. In this lower section, the river follows a straight path, and thick milfoil occurs throughout the channel, including the fastest moving section of the channel (the thalweg). These thick mats of vegetation slow down the thalweg and alter its path, contributing to a lack of pools and riffles. To help create hydrological diversity, milfoil will be raked out of the thalweg to help water flow more freely. In 2021, a rock deflector was installed near the end of DVNM15, where Milton

Creek combines with the Main Branch. The goal of the rock deflector was to scour out a pool and guide the river back toward its natural meander. Monitoring occurs above and below the deflector, but no monitoring has occurred in the section where stream bed scouring is taking place. CAWG will introduce additional monitoring of the streambed in the scouring zone to monitor the rock deflectors progress overtime. Additional deflectors will also be installed to help restore the river's meander and create pools that serve as migratory holding areas. These deflectors will have the added benefit of creating areas that support recreational fishing. To guide their placement, CAWG plans to take stream cross-section measurements every 10–20 meters between the forks and the Milton Bridge (DVNM13). Using this data, CAWG will consult with experts to strategically position three structures below the existing rock deflector.

Rainbow trout are known to superimpose redds over Atlantic salmon spawning areas, this has been observed in the West River. When this happens, survival to emergence is heavily impacted (Guignion et al., 2019). To investigate whether rainbow trout are utilizing salmon spawning areas and potentially superimposing their redds on top of Atlantic salmon redds, rainbow trout redd surveys will be conducted. Any installed spawning beds will be visited periodically to monitor for rainbow trout activity during the spawning season (Late Spring). Areas with dense salmon spawning may also be visited.

6.2.3.1 Strategies

- Perform patch cuts and tree plantings to increase riparian diversity below the forks.
- Take cross-section measurements every 10-20m from Milton bridge to the Forks to inform deflector placement.
- Place 3 additional deflectors below the rock deflector to create pools, improve the meander, and provide angling opportunities.

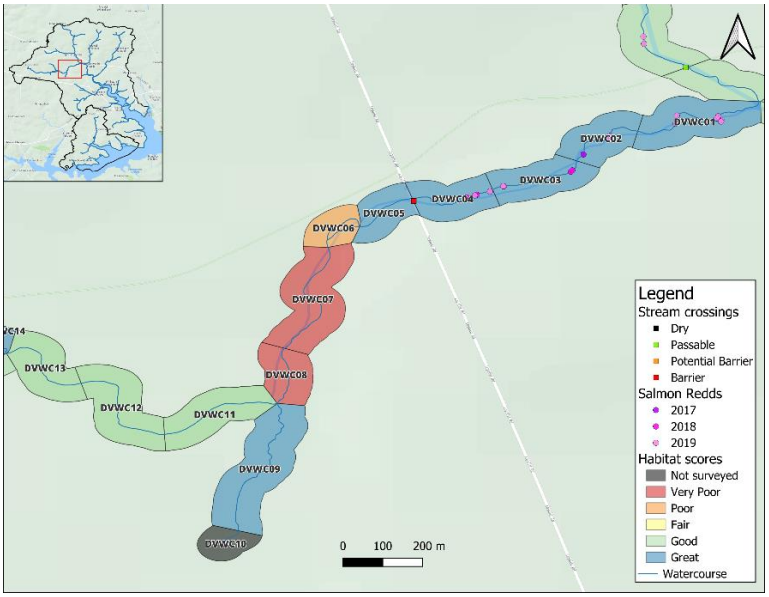
- Enhance current spawning areas by loosening substrate with rakes and removing fine sediments.
- Install spawning structures (soft engineered or artificial) in potential salmon spawning areas below the forks.
- Addition of preferred substrate will be added in potential spawning areas below the forks where non-preferred substrate is dominant.
- Continue to improve juvenile rearing habitat in riffle/run areas by flipping rocks.
- Survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Begin conducting rainbow trout redd surveys in late March to monitor potential spawning overlap with Atlantic salmon. Visit each survey area twice during the late spring.
- Develop strategies to introduce cover in the Route 2 culvert pool.
- Introduce woody material in DVNM21.

6.2.4 Watts Creek

Watts Creek is a westward branch of the North River Drainage Basin. It originates at its headwaters near Colville Road and flows to its mouth, where it joins the North River at the forks. It has a major tributary with headwaters near Kinkora Road. Watts creek is a third order river and has the most forested area of all tributaries in the North River watershed. Watts Creek contains the best spawning and rearing habitat in the entire watershed and is a major focus of enhancement activities like raking and rock flipping. **Figure 7 and Figure 8** show the results of DVAs on Watts Creek.

Figure 7

Lower Watts Creek Habitat Score Map



Note. DVA data for lower Watts Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. The best salmonid habitat for spawning and rearing is found in DVWC01-04. DVWC05 is also highly suitable but is blocked by the Loyalist Road culvert. Above DVWC05, habitat most resembles upper Watts, and is managed similarly. There is a considerable stretch of silt in most reaches above this point as indicated in the accompanying table.

Table 5

Lower Watts Creek DVA Summary

Reach ID	% of Silt	Barriers
DVWC01	25-50%	0
DVWC02	25-50%	0
DVWC03	0-25%	0
DVWC04	25-50%	0
DVWC05	0-25%	0
DVWC06	75%+	0
DVWC07	75%+	3+
DVWC08	75%+	3+
DVWC09	0-25%	3+
DVWC10	*	*
DVWC11	75%+	3+
DVWC12	50-75%	1-2
DVWC13	50-75%	1-2
DVWC14	50-75%	1-2

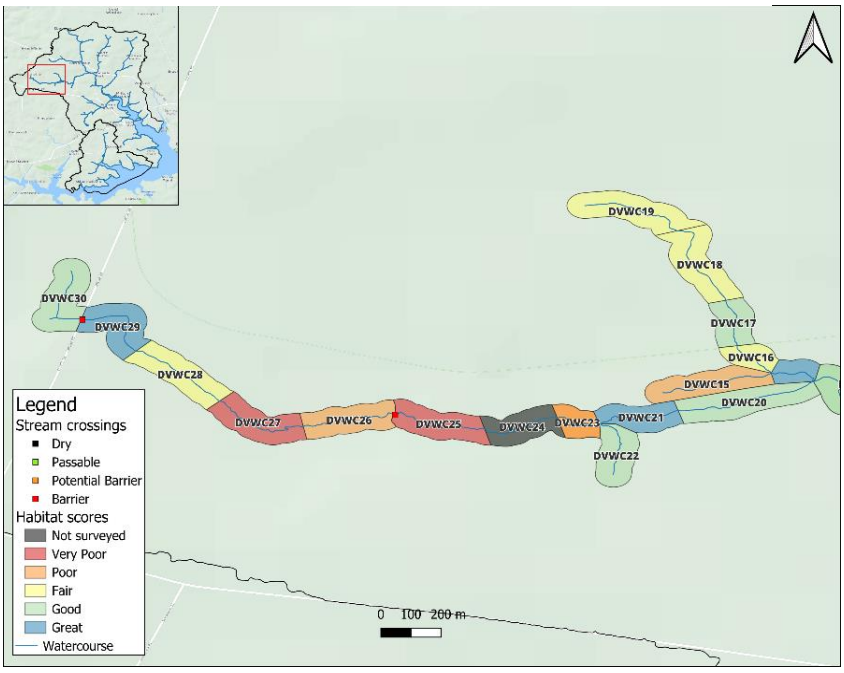
Note. Supplemental DVA data for lower Watts Creek. The barriers section does not include stream crossings and should be understood as potential barriers from blow down in the channel. * indicates that the survey was not completed due to extenuating circumstances.

According to **Figure 7**, the best salmonid habitat on Watts Creek is found below the Loyalist Road culvert. Recent restoration efforts, like brush mats, woody material management, and raking, have brought significant improvements to the substrate in this section. Since enhancement activities have been so successful, more attention may be paid to conducting woody material management and brush matting on other streams moving forward. However, lower Watts will still be monitored for blockages yearly, and brush matting and woody material management will still be done regularly on this section if necessary. Substrate enhancement activities, like raking and rock flipping, will continue annually on the lower sections to ensure large substrate remains available for spawning and rearing. As with North River Main Branch below the forks, expert opinion will be sought on suitable locations for spawning structures.

These structures will also be monitored for rainbow trout spawning activity in the late spring. While riparian buffer zones in lower Watts Creek are typically three layers of vegetation spanning greater than 15 metres, some strategic plantings to diversify the forest canopy will be undertaken on this section to help restore a healthy mix of coniferous and deciduous tree species. Figure 7 shows that the Loyalist Road culvert acts as a barrier to fish passage. Smelt migrations occur in the spring and usually only get up to the culvert. Planning is currently underway to improve the Loyalist Road culvert for fish passage. Since Watts is a salmon river, redd surveys are conducted on this tributary every year, typically to the Loyalist Road culvert. After fish passage is improved, assessments will continue above the culvert until the substrate is no longer suitable. Smelt migration surveys will also be conducted as a measure of connectivity.

Figure 8

Upper Watts Creek Habitat Score Map



Note. DVA data for upper Watts Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. Habitat on upper Watts is less suitable for salmonids, with long stretches of silt with no large substrate and barriers from stream crossings and blow down.

Table 6

Upper Watts Creek DVA

Reach ID	% of Silt	Barriers
DVWC15	75%+	3+
DVWC16	50-75%	3+
DVWC17	25-50%	3+
DVWC18	50-75%	3+
DVWC19	50-75%	3+
DVWC20	50-75%	3+
DVWC21	50-75%	0
DVWC22	25-50%	3+
DVWC23	75%+	3+
DVWC24	*	*
DVWC25	75%+	3+
DVWC26	75%+	3+
DVWC27	75%+	1-2
DVWC28	25-50%	3+
DVWC29	0-25%	3+
DVWC30	0-25%	3+

Note. Supplemental DVA data for lower Watts Creek. The barriers section does not include stream crossings and should be understood as potential barriers from blow down in the channel. * indicates that the survey was not completed due to extenuating circumstances.

Above the culvert, and on upper Watts (**Figure 8),** silt is a major limiting factor to salmonid habitat quality. There are considerable stretches of deep silt, with very little habitat diversity, and almost no large substrate (**See Tables 5 and 6**). Considering the upper portion of Watts has the most forest cover in the entire watershed, efforts beyond riparian plantings must be considered to combat this siltation problem. Visitation to these upper reaches will be essential to identifying sources of runoff and determining what can be done to improve the long-term health of upper Watts. Beyond siltation, another reason visitation to upper Watts is needed is the beaver dam located in the section. CAWG has been collaborating with landowners through various projects to manage siltation in upper Watts. To protect habitat downstream, a landowner allowed a sediment trap to be installed on their property to catch silt. The sediment trap has been effective in reducing siltation in reaches downstream. To ensure the sediment trap remains effective, CAWG monitors silt levels so excavation can occur when it is needed. In addition to the sediment trap, there is also an AgriWatershed Partnership project on upper Watts that CAWG has been monitoring. The project involved installing jute erosion mats in high sloped areas near a landowner's field to mitigate soil erosion. The jute mats are now in need of maintenance and may not be functioning to their fullest ability. CAWG will contact the AgriWatershed Partnership to facilitate the maintenance of this site, and ensure it is functioning properly. CAWG will provide updates about projects on upper Watts through social media posts to keep the community, and landowners potentially interested in collaborating, informed.

6.2.4.1 Strategies

- Continue collaborating with landowners to address siltation issues on upper Watts Creek. Make social media posts to inform the community of this important work.

- Increase visitation to upper Watts to search for point sources of erosion and to monitor the beaver dam.
- Enhance current spawning areas by loosening substrate with rakes and removing fine sediments. Addition of preferred substrate can be added in areas where non-preferred substrate is dominant
- In-stream channel maintenance on lower Watts at least once every three years (blockage clearing, brush matting) to encourage sediment storage and connectivity. Connectivity will be assessed every year prior to the Atlantic salmon spawning season.
- Conduct smelt surveys in the spring to monitor connectivity.
- Install spawning structures (soft engineered or artificial) in potential salmon spawning areas to increase habitat availability.
- Continue to improve juvenile rearing habitat in riffle/run areas by flipping rocks.
- Survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Begin conducting rainbow trout redd surveys in late March to monitor potential spawning overlap with Atlantic salmon. Visit each survey area twice during the spawning season.
- Monitor sediment trap for infilling.
- Contact AgriWatershed partnership about maintenance of jute mat project.

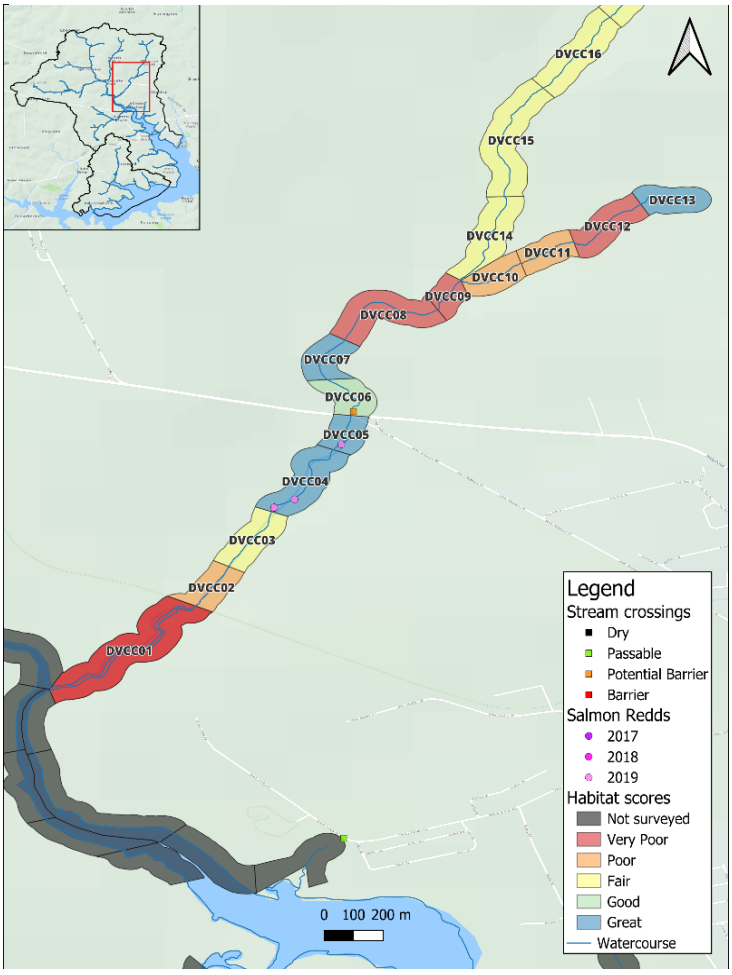
6.2.5 Coles Creek

Coles Creek can be described as a major tributary of the North River. Coles Creek runs from its headwaters at the Winsloe Road to its mouth where it meets the North River. In 2017, the City of Charlottetown began operating a well-field on Coles Creek. Since then, researchers from the Canadian Rivers Institute and the Department of Biology at UPEI have been monitoring

the impacts of wellfield water extraction on water temperatures, stream flows, and fish populations. In their report, Van Den Heuvel et al. (2021) indicated that extraction is impacting water temperatures and stream flows downstream, increasing water temperatures and decreasing stream flows. Work to quantify the impact on fish populations is still ongoing. The researchers should be contacted before any work is done on Coles that can significantly impact streamflow or water temperatures. Wells are found along reaches DVCC10-16 in **Figure 9** below.

Figure 9

Lower Coles Creek Habitat Score Map



Note. DVA data for lower Coles Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. The best salmonid habitat is found in DVCC04-05, below the Route 2 culvert. Well fields are found on DVCC10-16.

Table 7

Lower Coles Creek DVA

Reach ID	% of Silt	Barriers
DVCC01	75%+	0
DVCC02	75%+	0
DVCC03	75%+	0
DVCC04	0-25%	3+
DVCC05	0-25%	1-2
DVCC06	50-75%	0
DVCC07	25-50%	0
DVCC08	75%+	3+
DVCC09	75%+	1-2
DVCC10	75%+	3+
DVCC11	75%+	0
DVCC12	75%+	3+
DVCC13	25-50%	1-2
DVCC14	50-75%	3+
DVCC15	50-75%	3+
DVCC16	25-50%	3+

Note. Supplemental DVA data for Coles Creek. The barriers section does not include culverts and should be understood as potential barriers from blow down in the channel.

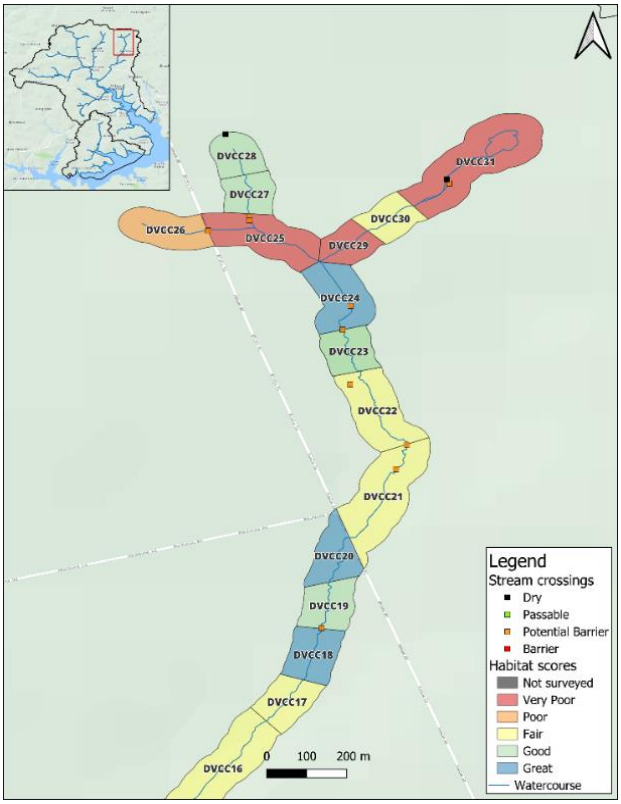
In previous years, Coles Creek was a considerable focus of restoration activities like brush matting and woody material management. However, visitation and restoration work on Coles Creek since 2017 has not been as frequent. With the establishment of the well field, gaining access to those stretches of the stream (DVCC10-16) has become more difficult. In 2024, CAWG was able to gain access to these reaches and conduct DVAs thanks to communication with the well field operators at the City of Charlottetown. The need to check in with the operators before accessing these stretches is a challenge to monitoring and restoration work. An additional challenge comes from the research being conducted on Coles Creek. Culvert replacements, woody material management, and brush matting can all have varying impacts on water temperatures and stream flows, important variables to the researchers. To allign goals, minimize conflicts, and facilitate data sharing, CAWG will seek to strengthen relationships with the Coles Creek researchers and well-field operators, and will ask for advice from both parties before conducting restoration work. CAWG will remain transparent about their activities on Coles Creek and will provide data and insight to researchers in the area. CAWG will periodically check in with researchers and will inquire with the City of Charlottetown about gaining less restricted access to the well field sites. Should any volunteer help for electrofishing or redd monitoring be requested, CAWG will happily provide assistance.

Another approach to minimizing conflict will be to focus on restoration activities that do not cause disturbances to flow or temperature measurements. CAWG has been doing this by planting trees and working to address silt and improve habitat on upper Coles (**See Table 8** and **Figure 10**). The silt on upper Coles primarily comes from the surrounding land, with many sections lacking healthy buffer zones. CAWG has been successfully collaborating with landowners near the headwaters to plant trees and gain access to upper reaches for visitation.

Landowners at the headwaters have been receptive to concerns about silt from surrounding land uses and will be approached about further tree plantings targeted at reducing runoff into the channel. Other activities that can aid habitat restoration while not causing disturbances to the stream are raking and redd surveys. In lower Coles, two reaches were used by salmon for spawning in 2019 (**Figure 9:** DVCC04-05). In these areas, fine sediment makes up less than 25% of the substrate, and the primary sediment size class is cobble. To ensure these habitats remain usable, they will be raked annually. To monitor spawning on lower Coles, redd surveys will be continued annually, and redd survey data from the Coles Creek researchers will also be sought.

Figure 10

Upper Coles Creek Habitat Score Map



Note. DVA data for lower Coles Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. There are many culverts and a lack of forest cover near the headwaters.

Table 8

Upper Coles Creek DVA Summary

Reach ID	% of Silt	Barriers
DVCC17	50-75%	3+
DVCC18	25-50%	0
DVCC19	50-75%	0
DVCC20	25-50%	0
DVCC21	75%+	0
DVCC22	75%+	0
DVCC23	25-50%	0
DVCC24	0-25%	3+
DVCC25	75%+	1-2
DVCC26	75%+	3+
DVCC27	0-25%	1-2
DVCC28	25-50%	1-2
DVCC29	75%+	3+
DVCC30	50-75%	1-2
DVCC31	75%+	1-2

Note. Supplemental DVA data for Coles Creek. The barriers section does not include culverts and should be understood as potential barriers from

6.2.5.1 Strategies

- Increase visitation to Coles Creek. Talk with the City of Charlottetown about gaining less restricted access to the well field reaches (DVCC12 –16)
- Maintain lines of communication with researchers at UPEI and the Canadian Rivers Institute.
- Rake riffles on (DVCC04-05).
- Continue collaborating with landowners to perform restoration work outside the channel to minimize disturbances to stream measurements (tree plantings in the upper portion of the watershed, reinforcing problematic banks.)
- Survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities

6.2.6 Milton Creek

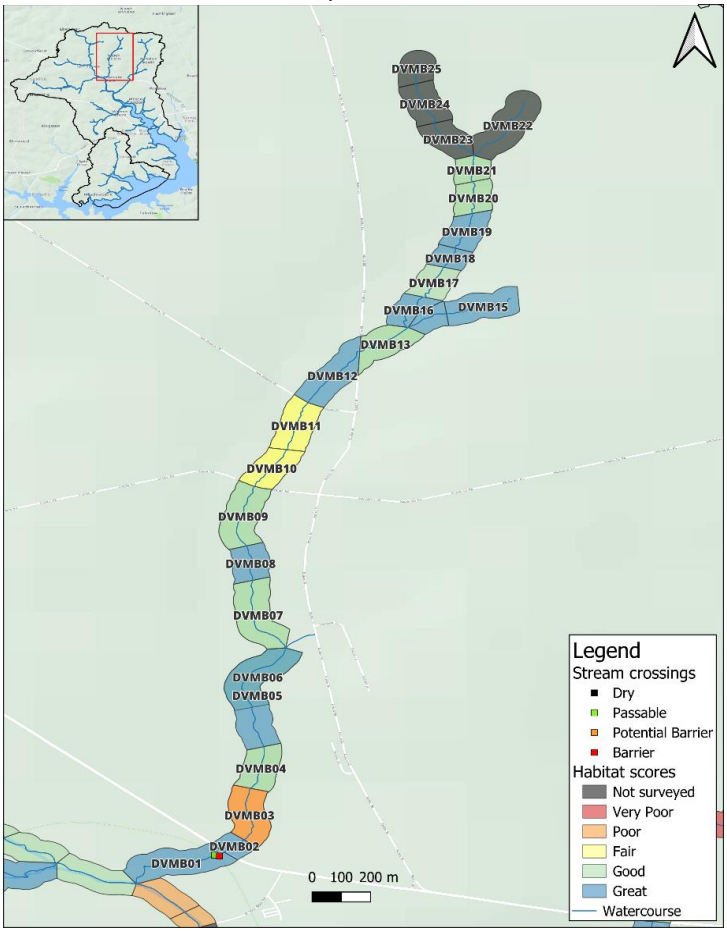
Milton Creek can be described as a major tributary of the North River. It runs from its headwaters near the Rustico Road to its mouth downstream from the Route 2 Highway. Despite its location near other salmon rivers in the North River watershed, evidence of historic salmon presence on Milton Creek is anecdotal. Juvenile salmon were caught in 2019 during an electrofishing course, but no official data has been found that supports Milton Creek being a historic salmon river.

Figure 11 shows that Milton Creek has several areas of high-quality habitat. The greatest strengths of Milton Creek are shade and the availability of large substrate in the majority of reaches. Access to quality habitat in higher reaches is potentially blocked during low flow conditions by a stream crossing at the Route 2 highway. Most of the stream crossings on this tributary are yet to be assessed, which will be a focus for future work on this system. Once more

stream crossings are assessed, the most problematic culverts can be prioritized for replacement. Although large substrate is available in most reaches, siltation is still a problem for Milton Creek as a whole (see **Table 9)**. A significant portion of the silt entering the creek comes from soil erosion from surrounding land. CAWG has been working together with landowners near Milton Creek to reduce the amount of soil runoff entering the stream. In summer 2024, a landowner terraced their field and installed a settlement pond to stop silt before it enters the stream. The success of this project showcases the power of collaborating with farmers to conserve their soil and protect stream ecosystems. CAWG will continue working with this landowner to make further improvements on their properties. Buffer zone coverage is relatively continuous throughout the system, with at least two layers of vegetation throughout, although DVAs were not conducted on the headwaters. The headwaters were visited for DVAs, but winter conditions made them impossible to assess. DVAs on the headwaters will be completed in the 2025 field season. A weakness of Milton Creek is habitat diversity with most sites falling into the 2-4 habitat type category. Introducing more cover and habitat types will be a priority for restoration work on this system given the longstanding relationship between cover and salmonid productivity (Raleigh, 1982). Given the possibility of Atlantic salmon activity on this tributary, redd surveys up to the Route 2 culvert will be added to CAWG's yearly redd surveys. If there is possible spawning identified, or if there is available time during electrofishing, an electrofishing spot check will be undertaken on this same stretch.

Figure 11

Milton Creek Habitat Score Map



Note. DVA data for Milton Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. Culverts are largely unassessed on this tributary. Habitat scores well (either good or great) in most reaches, although the headwaters were not assessed.

Table 9

Milton Creek DVA Summary

Reach ID	% of Silt	Barriers
DVMB01	50-75%	0
DVMB02	25-50%	3+
DVMB03	75%+	0
DVMB04	50-75%	1-2
DVMB05	50-75%	0
DVMB06	50-75%	1-2
DVMB07	50-75%	1-2
DVMB08	25-50%	0
DVMB09	25-50%	1-2
DVMB10	50-75%	1-2
DVMB11	50-75%	1-2
DVMB12	25-50%	0
DVMB13	50-75%	0
DVMB14	25-50%	0
DVMB15	25-50%	0
DVMB16	25-50%	0
DVMB17	25-50%	1-2
DVMB18	25-50%	0
DVMB19	25-50%	0
DVMB20	25-50%	1-2
DVMB21	25-50%	1-2
DVMB22	*	*
DVMB23	*	*
DVMB24	*	*
DVMB25	*	*

Note. Supplemental DVA data for Milton Creek. The barriers section does not include culverts and should be understood as potential barriers from blow down in the channel. * indicates that the survey was not completed due to extenuating circumstances.

6.2.6.1 Strategies

- Introduce soft-engineered habitat structures like cover logs, brush mats, rock structures, and digger logs to increase habitat diversity.
- Conduct DVA surveys on the headwaters.

- Continue collaborating with landowners on projects to mitigate soil erosion. Share these stories on social media to generate interest and collaboration.
- Conduct Redd survey from the mouth to the Route 2 culvert to search for potential salmon spawning activity.
- Survey stream crossings throughout the system to gather more information on the connectivity of the system.
- If time allows, conduct an electrofishing spot check somewhere below the Route 2 culvert.

6.2.7 Warren's Creek

Warren's Creek can be described as a major tributary of the North River. Warren's creek has two tributaries, one with headwaters near Route 225, and the other near Kingston Road. The tributaries combine near the Mill Road and then run to the mouth by North York River Road. Warren's Creek does not have Atlantic salmon.

Barriers throughout Warren's Creek act to limit movement between habitats. According to **Table 10**, one of the most impacted reaches is DVWA17, where severe blowdown creates connectivity issues throughout the entire reach. Reaches 9, 19 and 20a are also heavily impacted and have a high percentage of silt and fines in the substrate. Woody material management will be undertaken in these reaches to restore connectivity and get sediment moving through the system. In addition to blowdown, **Figure 12** shows several culverts along the creek that restrict fish passage under low flow conditions, with at least two culverts between DVWA10 and DVWA18 remaining unassessed. Restoration efforts will focus on identifying and addressing these barriers to improve connectivity. Efforts will involve working with the Department of Transportation and Infrastructure to resolve culvert issues on public roads, and helping landowners secure funding to

improve private stream crossings should problematic culverts on private land be identified. On top of connectivity issues, landowner activities in the buffer zone are also a significant concern. Problems persist with cattle being allowed into the stream, temporary stream crossings being built and collapsing, and garbage accumulating in riparian areas. CAWG will contact landowners and encourage them to fence cattle out of the stream. If necessary, Shawn Schofield, the Ag-environment team leader, will be contacted to help facilitate collaboration between CAWG and landowners. CAWG will also document problematic structures within the buffer zone and follow up with landowners to ensure regulations are being followed. Public campaigns through social

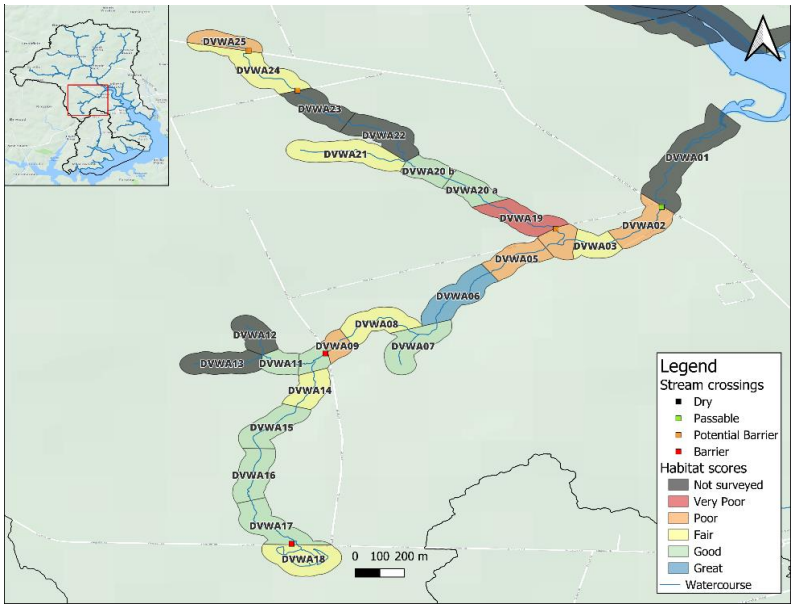
media posts and networking will bring attention to the potential impacts of human activities in riparian zones and will share ways we can protect buffer zones.

6.2.7.1 Strategies

- Conduct woody material management on DVWA 9, 17, 19, and 20a.
- Conduct culvert assessment on unassessed culvert by DVWA14. Reach out to landowners to assess any additional culverts upstream.
- Should culvert by DVWA14 or on upstream reaches be deemed problematic, talk with landowner and try to secure funding.

Figure 12

Warren's Creek Habitat Score Map



Note. DVA data for Warren's Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. Culverts are ranked as barriers, potential barriers, or passable. Of the 6 culverts surveyed on Warren's, 2 were deemed barriers, 3 potential barriers, and one as passable. There are still at least 2 culverts that are not assessed on this tributary.

Table 10

Warren's Creek DVA

Reach ID	% of Silt	Barriers
DVWA01	*	*
DVWA02	75%+	1-2
DVWA03	50-75%	1-2
DVWA04	75%+	0
DVWA05	50-75%	1-2
DVWA06	50-75%	0
DVWA07	50-75%	1-2
DVWA08	75%+	1-2
DVWA09	50-75%	3+
DVWA10	50-75%	0
DVWA11	50-75%	0
DVWA12	*	*
DVWA13	*	*
DVWA14	50-75%	0
DVWA15	50-75%	0
DVWA16	50-75%	0
DVWA17	25-50%	3+
DVWA18	75%+	0
DVWA19	75%+	3+
DVWA20 a	25-50%	3+
DVWA20 b	50-75%	0
DVWA21	75%+	1-2
DVWA22	*	*
DVWA23	*	*
DVWA24	50-75%	0
DVWA25	75%+	1-2

Note. Supplemental DVA data for Warren's Creek. The barriers section does not include culverts and should be understood as potential barriers from blow down in the channel. * indicates that the survey was not completed due to extenuating circumstances.

- Encourage landowners to fence cattle out of the stream.
- Document structures within the buffer zone and follow up with landowners.
- Clean up garbage in riparian areas and bring attention to the impacts of human activities in buffer zones through social media posts.

6.2.8 Hyde Creek

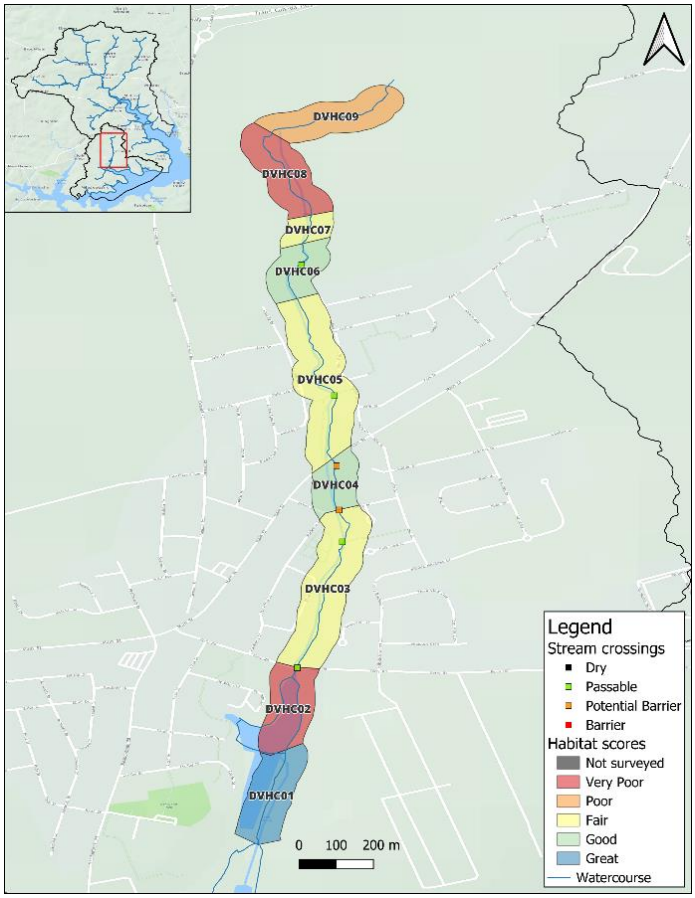
Hyde Creek is a sub-watershed of the West River with a drainage area of approximately 2,009 hectares and 5.9 km of streams. The headwaters are near the Trans-Canada Highway while the mouth is where it meets the West River. In 2024, the Hyde Pond spillway was redesigned to improve fish passage. With this redesign, it is hoped that smelt migrations will return to Hyde Creek.

Figure 13 shows that fish passage is potentially blocked by two culverts, one on Main Street and the other on James Street. The Main Street culvert is particularly concerning, with no outlet pool, a large inlet drop, and significant amounts of debris scattered throughout the culvert. CAWG will attempt to clear this debris during the 2025 field season. Should any problems be encountered, the Department of Transportation and Infrastructure will be contacted about what can be done to clean up the Main Street culvert and improve fish passage. One of the factors that held back habitat scores on Hyde Creek was a lack of cover and habitat diversity, particularly on

DVHC03, which has stretches of deep silt, with no large substrate or undercut banks for cover. Woody material will be strategically added to this reach to introduce cover in these barren areas.

Figure 13

Hyde Creek Habitat Score Map



Note. DVA data for Hyde Creek showing habitat scores and stream crossings. Habitat scores are based on substrate composition, shade, barriers to passage, presence of pools and springs, and the amount of cover types in each reach. Culverts are ranked as potential barriers or passable. Culverts on James and Main Streets are potential barriers as shown by the orange squares on the maps.

Table 11

Hyde Creek DVA Summary

Reach ID	% of Silt	Barriers
DVHC01	25-50%	0
DVHC02	75%+	0
DVHC03	50-75%	1-2
DVHC04	25-50%	1-2
DVHC05	25-50%	3+
DVHC06	0-25%	1-2
DVHC07	25-50%	1-2
DVHC08	75%+	3+
DVHC09	75%+	3+

Note. Supplemental DVA data for Hyde Creek. The barriers section does not include culverts and should be understood as potential barriers from blow down in the channel.

Hyde Pond, a former mill pond, is found below the Ferry Road. Water exits the Hyde Pond through a spillway and the newly constructed natural bypass channel. Below the bypass channel, effluent from a Cornwall water treatment facility is discharged into Hyde Creek. An electrofishing spot check in 2023 and subsequent field observations revealed that the species

composition below the spillway (DVHC01) is markedly different from that in the reaches above the pond. Despite this reach receiving the highest salmonid habitat score in the watershed, no brook trout and only two rainbow trout were captured during the 2023 electrofishing survey. Investigating why brook trout seem to avoid this high-quality habitat and assessing the impact of the effluent on smelt migrations are top priorities for CAWG's management of Hyde Creek. To investigate, CAWG will consult with Cornwall's water treatment officer to better understand the effluent's composition, treatment processes, and its potential effects on fish. Complementary water quality testing, guided by PEI's surface water biologist, along with continued electrofishing spot checks above and below the spillway, will help monitor the salmonid populations and overall health of Hyde Creek. In addition to water quality concerns from effluent, the Hyde Creek watershed faces significant environmental pressures from agricultural land and concentrated urban development that also threaten water quality. As shown in **Table 11**, most of the reaches on Hyde Creek have more than 25 percent silt and fines in the substrate. Most of this silt comes from the surrounding land, originating as soil erosion or road runoff. To help filter runoff before it reaches the stream, buffer zone plantings will be undertaken. These plantings will also increase riparian tree cover and push buffer zones towards a healthy species mix. Leveraging a strong and growing relationship, the Town of Cornwall, which owns a significant portion of riparian land, will be approached about planting trees on their properties.

Another problem impacting habitat quality is litter. Hyde Creek is increasingly affected by litter accumulation along its banks and within its channel. As this litter breaks down, it introduces microplastics and other pollutants into the environment. To combat this, CAWG hosts the annual "Trees for Trash" event, aimed at cleaning up litter throughout the entire watershed. Complementing this strategy are cleanups undertaken by the crew during the field season. To

help Hyde Creek and the citizens of Cornwall thrive together, while combating problems like littering, CAWG will continue educational campaigns aimed at providing information about practices around water courses through social media posts and community events.

Another significant issue faced by the Hyde Creek is the spread of invasive species. Invasive species, like Japanese knotweed, are present in pockets throughout the watershed. CAWG manages two Japanese knotweed sites near Hyde Pond, but several upland areas also have invasive species. CAWG will continue managing invasives in riparian areas and will look to create opportunities to involve community members in invasive species management throughout the watershed. This will be done through volunteer opportunities, educational campaigns, and cooperation with the Town of Cornwall.

6.2.8.1 Strategies

- Clear debris from the upstream end of the Main Street culvert. Should problems be encountered, contact the Department of Transportation and Infrastructure about cleaning up the stream crossing on Main Street.
- Strategically introduce woody material to DVHC03 to improve fish cover.
- Establish water quality monitoring and improved temperature monitoring through collaboration with Cornwall's water treatment officer and PEI's surface water biologist. Place any monitoring equipment in inconspicuous areas to avoid vandalism.
- Monitor Hyde Pond's dissolved oxygen, and temperature at the inlet and outlet.
- Monitor Hyde Pond outlet structure and bypass channel for smelt migrations
- Conduct yearly electrofishing spot checks above and below Hyde Pond.
- Work with the Town of Cornwall to plant trees on land owned by the town.

- Continue managing invasive species in the watershed. Collaborate with the Town of Cornwall to involve Cornwall residents in invasive species management.
- Continue garbage clean up through community events, and garbage collection days in the field season.
- Continue education and outreach with residents about best practices around watercourses.
- Improve community outreach through signage and community events like the Trees for Trash and Bioblitz.

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