Central Queens Branch of the
P.E.I Wildlife Federation
Fish Habitat Management Plan for the
West River Watershed and Clyde River

Updated: 2020

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1. The Watershed

a. West River

The West River drainage basin is the third largest watershed on Prince Edward Island (PEI), draining 20,525 ha of land and supporting more than 320 km of stream. The bulk of the West River drains from the Bonshaw Hills and many of the streams have above average gradients when compared to other watercourses on PEI. The river is heavily spring-fed, which moderates seasonal water temperatures and flows.

The watershed can be divided into seven (5) sub-watersheds or tributaries above the head-of-tide: Ross Brook / Brookvale (including Skye Brook), Quinn's Brook, Howell's Brook, Riverdale / Green Bay, Black Brook and the main branch upstream from the Dunedin bridge through to the Bolger Park bridge. About 52% of the upper watershed is under forest cover, 42% in agriculture and about 4.5% developed. However, in each sub-watershed the proportion of forested land can vary considerably. For example, Black Brook sub-watershed is 70% forested, while Quinn's Brook has a mere 27% under forest cover

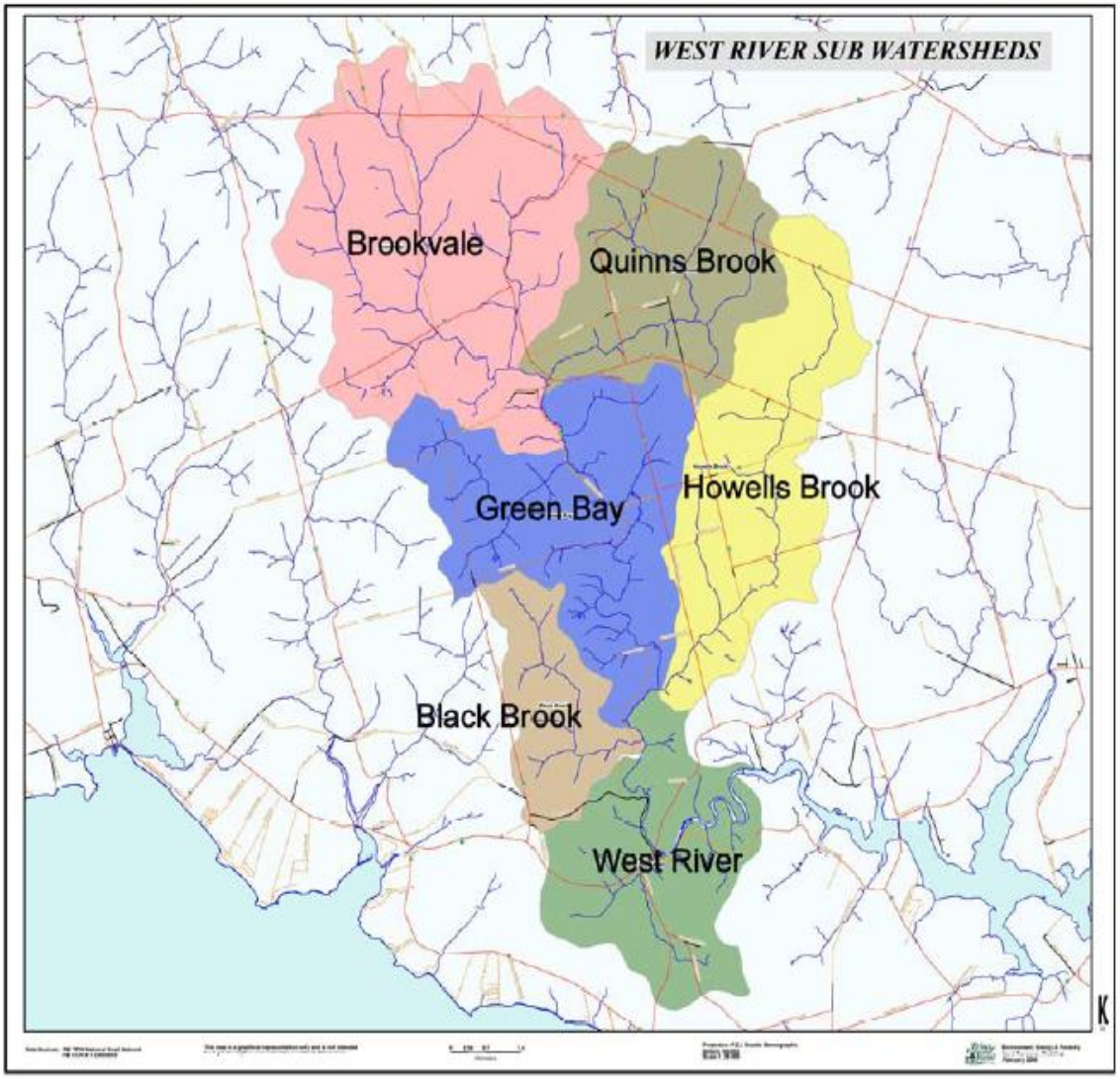
b. Clyde River

The Clyde River is a sub-watershed of the West River, draining into the same estuary below the head-of-tide. Like the vast majority of rivers on PEI, the Clyde River had a history of running an assortment of mills (grist, saw, and flour). Today, we see remnants of forest that were not logged resulting in ~69% of the land used for agriculture purposes and only 19% in forest cover. As one would expect, environmental problems are often closely tied to the amount of land under forest cover, land stewardship and the intensity of land use activities. Despite this, the amount of row cropping is relatively low and the majority of the farming is beef livestock and dairy. Much of the watershed is deforested, but there is less tillage than might be expected in comparison to other areas of PEI. Nonetheless, there are persisting issues with keeping cattle out of the many tributaries and limiting bank destabilization and sedimentation due to past and continuing cattle access. The issue of excess nutrient inputs is also present. For the

purpose of this Fish Habitat Management Plan the Clyde River watershed can be broken down in three management section/areas; the West branch or Baltic Brook (reaches towards Colville road), East branch (reaches northeast past Kingston road), and the main river extending north from the hide-of-tide until headwater region.

Sadly, fish kills happen far too often and are reoccurring events here on PEI. On the Clyde River, the most recent fish was in 2016 on the West branch originating close to the Colville road. In the past, there were other fish kills recorded in 2002, and 1999. The most recent fish kill recorded on the West River was in 1971.

Fig 1. Map of West River sub-watersheds



2. The West River Watershed Project, Central Queens Wildlife Federation

From 2005 – 2007, a watershed management plan (WMP) was developed by the Central Queens Wildlife Federation, with help from numerous local residents and stakeholders (see West River Watershed Management Plan 2008). The PEI Wildlife Federation has been in existence for over a century and branches such as Central Queens have been driving forces in watershed planning and ecosystem management. Details about the overall objectives and long-term planning can be found in the WMP, but essentially the Wildlife Federation hopes to encourage good land stewardship within the drainage basin and restore and enhance wildlife habitat both within watercourses and in their adjacent riparian buffer zones.

3. Present Fisheries Resource

Like all PEI streams, few species of fish exist in the Clyde and West Rivers when compared to similar mainland streams. Various species of sticklebacks (*Gasterosteidae sp.*), silverside (*Atheriniformers sp.*), winter flounder (*Pseudopleuronectes americanus*) and mummichog (*Fundulus heteroclitus)* occur in the estuary and to a lesser extent in brackish water. Anadromous fish such as Rainbow smelt (*Osmerus sp.)* and blue-backed herring (gaspereau or *Alosa aestivalis*) migrate upstream to spawn in spring or early summer. Catadromous species such as American eel (*Anguilla rostrata)* are also present. A modest run of late spawning (November) Atlantic salmon (*Salmo salar*) inhabits the West River and was last detected on the Clyde River in 2012 (see table 1). Rainbow trout (an introduced species) (*Oncorhynchus mykiss*) are thriving in all sub-watersheds and of course brook trout (*Salvelinus frontinalis*) are also abundant throughout the drainage basin.

Table 1. Salmon redd count surveys on the West River since 2010 (* indicates an incomplete count).

Year	2010	2011	2012	2013	2014	2015	2016	2016	2017	2018	2019	2020
# of Redds	88	90	89	168	113	113	113	146	149	124*	113	101

4. Monitoring and Assessment

Populations of fish moving up the West River were monitored through the use of a fish fence and trap during the 1990s. In more recent years, fish populations at 8 index sites have been monitored by electrofishing on an annual basis on the West River. Four additional sites are surveyed for fish densities annually on the Clyde River. Densities and size classes of salmonids were measured during these surveys. Up until 2011, brook trout brood-stock were collected on an annual basis, offspring raised at the Dover Fish Hatchery (formerly Cardigan Fish Hatchery) and, the young fish released back to the river system (if no fish kills occurred in other PEI systems that drain into the Hillsborough estuary that would require re-stocking with the hatchery stock). Annual redd surveys have also been conducted for Atlantic salmon on the West River from 1990 – 96 and 2008 – 20; while conducting redd surveys, trout spawning areas and another critical habitat were always noted. On major tributaries water temperature and nutrient concentrations are monitored twice annually; once during low and high flow periods. In total 16 index sites are monitored (10 on the West River and 6 on the Clyde River). Temperature data loggers were installed at 14 sites throughout the West River to monitor annual temperature regimes. The highest recorded temperature for 2020 was 18.4 degrees Celsius on August 14th.

5. General Problems and Issues for Fish

Water quality data are found in the West River Watershed Management Plan. Generally, the basic water quality in the West and Clyde Rivers appear relatively good. Heavily influenced by springs, water temperature is relatively low in summer (ideal for salmonids) and moderated in winter. Problems do exist with excess nutrients and nitrate levels in some tributaries. The major water quality problem is due to soil erosion from various forms of land use (agriculture, cattle in stream, unpaved roads, ditches and development). Cattle that are not fenced out of the stream contribute to the water quality issue, and are a larger issue in the Clyde River when compared to the West River. Sediment inputs in some tributaries are high. In addition, there are heavy in-stream

sediment bed-loads as a result of historic non-point and point-sources of erosion in combination with dense obstructions of speckled alder along the river-banks produced by past removal or alteration of riparian zone vegetation. The natural mix of gravels and cobble are occasionally buried under a metre or more of sediment, limiting spawning habitat quality and quantity within the watershed. Suspended sediment also can be stressful to fishes during heavy rain events when the river and its tributaries turn red.

Fish passage is an issue at a number of road crossings within the watershed. In May 2011, an inventory of culverts identified at least 25 (14 West River and 11 on Clyde River) perched, unbaffled, improperly installed or damaged culverts along the river above the head-of-tide. On the Clyde River the western half of the river is effectively blocked for fish passage by a badly perched culvert on Bannockburn Rd. Lesser fish passage issues occur at culverts for blue-backed herring and rainbow smelt further up Bannockburn Rd, as the road crosses back and forth several times en route to the headwater springs. These present barriers to some or all anadromous fishes during their migrations to and from spawning grounds in freshwater. The two remaining impoundments on the West River (Crosby's and Carragher's Ponds) both have functioning fish access measures (a run-around bypass channel and a fish ladder, respectively).

Fish cover and habitat diversity is also an issue in many reaches of the West and Clyde Rivers. Because of the gradient, surrounding terrain, altered riparian vegetation and sediment deposition, there are relatively few natural deep pools on the West and Clyde Rivers. The historic land use in the area has resulted in the majority of the mature forest cover removed, leading to soil erosion in the headwater areas, channel aggradation, and the missing component of woody debris within the stream. Over time this has lead to the stream channel infilling with fine sediments and severe channel aggradation to occur. The sedimentation issue means that stream embeddedness is prevalent in many reaches. Access to springs adjacent to streams as refuges for young fish or for spawning of brook trout is sometimes blocked by sediment and debris. Many

of the existing deep pools occur in association with culverts, where fish are susceptible to higher angling pressure.

The presence of the introduced rainbow trout may also be emerging as a problem of unknown proportions. Preliminary surveys suggest that the spring-spawning rainbow trout select the same spawning locations as Atlantic salmon in the West River, and may be disturbing or destroying un-emerged young salmon during the process. In many respects, rainbow trout could have a competitive advantage over the native salmonids, due to tolerance for higher water temperatures and poorer water quality.

6. General Strategies for Fish Management

The identification and assessment of sediment input sites has begun and will be ongoing for many years. Newer technologies for more accurate assessment are being sought. The help of landowners will be sought to address current sources of sediment, by encouraging best management practices with agriculture, logging, roadworks and development. Working with landowners to fence cattle out the river is in progress and has made major improvements since 2012, but still requires more fencing to occur. In areas that have been recently fenced, riparian planting should take place once the cattle are secure from the area to ensure proper vegetation regrowth. In some sub-watersheds, in-stream sediment traps and/or sediment bypass ponds should be installed to prevent further degradation of streams in the short-term, and to capture the historic bed-load of sediment released during stream obstruction removal work. These traps and ponds may initially need to be “cleaned” a couple of times but with “fixing” the sources, sediment issues should gradually diminish.

The Department of Transportation and Infrastructure Renewal has prioritized and agreed to fix all problem public road culverts within the West and Clyde River watersheds, as resources are available and also to work with the provincial Department of Agriculture and Forestry to find solutions for major field run-off sites. We will attempt to find funds to address fish passage issues at private road crossings within the

watershed. The pursuit of a long-term solution to the bank erosion issue caused by the run-around bypass channel at Crosby's Mill is also underway, with the collection of professional advice from hydrologists and biologists.

Fish cover and habitat diversity can be restored through a series of strategies, including riparian margin Acadian forest planting and in-stream structural restorations such as installation of large woody debris (split logs, digger logs, whole logs), brush-matting and flow deflectors. In these instances, we will take our guidance from the Technical Manual for Watershed Management on PEI (2012 edition). Priority will be given to reaches high in the watershed with the rationale that habitat restoration should be addressed in an upstream – downstream fashion. Priority will also be given to Atlantic salmon, as COSEWIC has listed it as a species of 'special concern' in this region.

DFO is currently undergoing a study that allows them to identify dietary items of Atlantic salmon parr. On a taxonomic scale, they are able to identify the containments of the sample down to genus and even species using DNA sequencing and barcoding. By comparing agriculture-impacted sites to more pristine sites, the food availability and what the salmon have been selectively feeding on may draw a connection between dietary habitats and the overall integrity of the streams aquatic ecosystem.

7. Specific Management Strategies by Tributary or River: West River

Note: Management strategies initiated in 2010, revised in 2019

a) Riverdale and Greenbay (main river), West River

Extending from Crosby's Pond (1km above head-of-tide) until the end of the Elliott River road, this is the main section of river, which covers wide variety of river habitat characteristics. Nearing 15 km of stream distance it contains the bulk of salmon spawning grounds, and has sections of old growth forest. There is a major transition of forest cover at one point, shifting from a mature forest cover in the lower reaches to dense alder growth in the upper reaches. The stream channel follows the shift in forest cover; where the forest cover is full and mature the meander is slower and more gentle,

while in the dense alder growth areas the meander is tighter turning, and more inconsistent. The sediment load varies throughout the entire section, but is still considered the biggest limiting factor. Black Brook, and Gass Brook are smaller tributaries that feed into this reach.

Riparian Management:

- Encourage farmers to continue with current best management practices, including a 4-year crop rotation
- Plant native tree and shrub species each year in the buffer zone, patch cutting dense alders, problem mature white spruce and replacing with natural riparian species, taking care not to remove impact on protective grasses adjacent to row crop fields
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts. The section of Greenbay following the Elliott River road (~5km) will require extensive amounts of patch cut plantations

Restore Degraded Fish Habitats:

- Remove excess brush, debris and maintain a free-flowing channel for fish passage but being careful to maintain or replace large woody debris as cover for various year classes of salmonids
- Install brush mats throughout the watercourse to capture sediment and narrow the stream channel where desired (mainly in Greenbay and along Eliot River Rd.
- Construct / install split logs, full cover logs, digger logs and rock riffles to restore fish cover and diversify habitat (Installation of LWD is required in the fishing area “Sweeney’s” and along entire lower main branch)
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters for juvenile salmonids. Ideally below major spawning areas)
- Rake and manually breakup substrate at identified salmon spawning sites (~30 sites) to remove silt and add clean cobble/gravel substrates from nearby sources (cover 2x3m and 0.5m deep patches)

Monitoring:

- Check during springtime along entire section for problematic winter and ice storm blow downs and obstructions
- Perform salmon and trout redd count survey during spawning season
- Flow and Monitor water temperature and nutrient concentrations at Crosby's Pond during the summer during low and high flows

Additional Management Suggestions:

- Begin working with landowners in restoring the 5km section above Greenbay culvert. Seeking permission to perform restoration activities on their land (restorations activities were initiated during 2018 and will require multiply years to complete)

b) Quinn's Brook, West River

The Quinn's Brook sub-watershed includes several kilometres of varying gradient stream below Carragher's Pond, the pond itself and three high-gradient but relatively short reaches of stream above that. In recent years Atlantic salmon have spawned along a 200m section below Carragher's Pond, this area will be a priority for protection.

The riparian buffer zone is mostly intact and there are several areas of mature riparian forest. In the past, however, soil eroded from a small number of steep fields and roadways, resulting in much sediment reaching this brook. A few gullies persist, although farming practices have improved markedly in very recent years.

There is a concern that nitrate loading from dense residential development on very steep land may be an issue in this brook, although further background data must be collected before an adequate assessment can be made. Organic matter exacerbates any sedimentation issue around salmon redds, as it has been shown to increase egg mortality significantly.

Riparian Management:

- Encourage landowners to protect a wider forested riparian zone than the regulated 15 m buffer
- Plant native tree and shrub species each year in the small number of patches where alders or mature white spruce currently dominate
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts
- Continue to expand the ALUS project area at Jeff Campbell's and Stefan Seller's in headwater region (+500 trees over the next three years)

Restore Degraded Fish Habitats:

- Remove excess brush and debris where bank destabilization is occurring, but otherwise retain all large woody debris in-stream; use brush mats sparingly taking care not to pinch the stream
- Construct / install split logs, full cover logs, digger logs and rock riffles to restore fish cover and diversify habitat once the sediment issue has been resolved
- Maintain sediment bypass pond immediately upstream of Mill Rd, and at top of Carragher's Pond. Work with upstream row-crop growers and the Department of Transportation and Infrastructure Renewal to address persisting sediment inputs
- Restore the original depth in the pond at the top of Mill Rd, to prevent the entrapped sediment from migrating downstream
- Maintain Carragher's Pond and the associated fish ladder to retain upstream access to brook trout and Atlantic salmon
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)
- Restore salmon spawning habitat along the section between Clarkin and Peter's Rd

Monitoring:

- Carry out electrofishing surveys to determine juvenile salmonid densities in selected index locations

- Monitor water temperature and nutrient concentrations downstream of Carragher's Pond during the summer during low and high flows
- Monitor the rate of in-filling of all ponds
- Check during springtime along entire section for problematic winter and ice storm blow downs and obstructions

c) Howell's Brook, West River

The Howell's Brook sub-watershed was historically described as the best Atlantic salmon habitat on the West River. Today, while a few salmon continue to spawn in the lowest reaches, most of the brook (above Peters Rd) is heavily choked with sediment and excessive alder growth. Major progress has been made in such alder choked areas in recent areas. A 700m section above the Wynn road has made remarkable progress since 2016; starting as a oozing flow through excessive alder growth and now has a meandering, free flowing channel with trace amounts of spawning substrates beginning to appear.

Riparian Management:

- Encourage farmers to continue with current best management practices, including a 4-year crop rotation
- Plant native tree and shrub species each year in the buffer zone, patch cutting dense alders, problem mature white spruce and replacing with natural riparian species, taking care not to remove impact on protective grasses adjacent to row crop fields (mostly above Peters and Wynn road in alders and along fields)
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts

Restore Degraded Fish Habitats:

- Remove excess alders in-stream above Peter's Rd to Kingston Rd
- Construct / install split logs, full cover logs, digger logs and rock riffles to restore fish cover and diversify habitat once the sediment issue has been resolved

- Maintain a sediment bypass pond upstream of Peters Rd to protect high-quality downstream habitat (including existing Atlantic salmon spawning grounds)
- Downstream of Peters Rd, remove only the large woody debris that is producing excessive bank erosion.
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)
- Establish frequent (every 200m) Class A (2x long as wide and +1m deep) holding pools to spawning areas
- Resolve any major braid in stream channel or unnatural meander patterns, in particular, resolve a braid at the mouth of Howell's Brook where it meets the main river to encourage fish migration into Howell's Brook.
- Continue restoration activities up past Quinn Rd until Kingston road (2019)

Monitoring:

- Carry out electrofishing surveys to determine juvenile salmonid densities in selected index locations, including the introduced competitor rainbow trout
- Monitor nutrient concentrations downstream of Bluefield High School and at index sites
- Check during springtime along entire section for problematic winter and ice storm blow downs and obstructions
- Perform salmon and trout redd count survey during spawning season

d) Ross Brook (Brookvale), West River

Each stream reach has different in-stream and riparian zone habitat dependent upon gradient, deforestation and land use activities. The Brookvale sub-watershed has a low gradient reach immediately upstream from Route 13. This 1 km zone was heavily inundated with alders, both in and along the stream prior to 2010. Excessive sediment deposition occurred in the reaches with dense alders.

Upstream from the "flat" reach, the gradient increases. Other than attempting to "fix" roadway or agricultural input problems, most activity will be focused on in-stream

alterations to improve juvenile trout and salmon habitat. The riparian zone quality in these reaches varies but often many of the desirable tree species are present. These upper reaches of the West River should be prime production areas for salmonids because of water quality, but basic ingredients (spawning gravel, easy movement, appropriate cover, etc.) are often lacking. The removal of sediment just upstream from Route 13 should afford protection for all the important downstream river reaches where trout and salmon spawn.

Riparian Management:

- Continue to encourage landowners to leave an appropriate riparian zone, if possible in excess of provincial guidelines
- Continue planting native tree and shrub species each year within the riparian zone until an Acadian forest mix has been restored
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts

Restore Degraded Fish Habitats:

- Remove excess brush and debris, being careful to maintain or replace large woody debris and cover for various year classes of salmonids
- Maintain a sediment bypass pond immediately upstream of Route 13 and an in-stream sediment trap upstream of Ross Rd to capture sediment liberated during stream restoration activities and protect downstream habitat. Clean-out will occur less frequently as the majority of the sediment is stabilized or removed from upstream reaches.
- Install brush mats throughout the watercourse to capture sediment and narrow the stream channel where desired
- Construct / install split logs, full cover logs, digger logs and rock riffles to restore fish cover and diversify habitat once the sediment issue has been resolved
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)

Monitoring:

- Carry out an in-stream habitat assessment prior to restoration activities
- Carry out electrofishing surveys to determine juvenile salmonid densities in selected index locations
- Monitor water temperature and nutrient concentrations during high and low flows
- Monitor the rate of in-filling of all sediment collection traps

8. Specific Management Strategies by Tributary or River: Clyde River

Note: Management strategies initiated in 2011, strategies still in progress

e) Main River above head of tide (Bannockburn Rd) including Dixon Brook, Clyde River

The main section of river extending 6.6 km above the head-of-tide. The stream channel follows the Bannockburn road, crossing back fourth several times until crossing the Kingston road. The majority of land usage is grazing pastureland for cattle, with little to no mature surrounding forest aside from the head-of-tide area. Cattle use the stream for access to grazing pastures and fencing them out is still in progress. Areas that were recently fenced, or are still in the progress of having the cattle fenced out, experience bank instability and water quality issues. At the head-of-tide there is an old earthen dam that was constructed for the old mill, remnants are still present today at the site. The old mill site is located on the Dixon's property and the unnatural by-pass channel is resulting in severe bank erosion in multiply areas. The Clyde River historically supported Atlantic salmon populations, and at our electrofishing index sites along the main river Atlantic salmon were last detected in 2012. This section is high priority and will be targeted for intense in-stream restoration efforts as it recently supported Atlantic salmon stocks.

Riparian Management:

- Encourage landowners to protect a wider forested riparian zone than the regulated 15 m buffer

- Increase native tree/shrub densities within the 15m buffer zone (plant deep rooting, long-lived Acadian forest sp.)
- Plant native tree and shrub species each year in the patches where alders or mature white spruce currently dominate; under plant existing riparian forests with species that are missing, including hemlock, cedar, ash, white pine and yellow birch
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts
- Encourage landowners to fence any remaining unfenced tributaries where there are still cattle accessing the stream (Dixon's Brook, and upper Dixon's property)
- Plant native tree and shrub species to stabilize banks where cattle previously accessed the stream

<u>Restore Degraded Fish Habitats:</u>

- Work with the Department of Transportation and Infrastructure Renewal to correct fish passage issues at all public culverts on Bannockburn Rd
- Remove excess brush and debris where bank destabilization is occurring, but otherwise retain all large woody debris in-stream; use brush mats sparingly taking care not to pinch the stream
- Maintain and continue to cleanout in-stream sediment trap below east branch and main river forks, and the by-pass sediment trap at Willy's Lane
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)
- In-stream channel maintenance at least once every three years (blockage clearing, brushmatting)
- Improve head-of-tide habitat for anadromous fish spawning ie- blue-backed herring and rainbow smelt (pool creation and culvert passage)

<u>Monitoring</u>:

- Carry out electrofishing surveys to determine juvenile salmonid densities in selected (2) index locations

- Monitor water temperature and nutrient concentrations at (2) index sites during high and low flow
- Monitor the rate of in-filling at in-stream sediment trap

f) West Branch Tributary (Baltic Brook), Clyde River

The West branch crosses under the Bannockburn and heads westward towards the Colville road. The largest tributary on the Clyde River, covering close to 7 km, is heavily impacted from sediment loading by agriculture practices in the headwaters region. The majority of the mature forest has been removed since European arrival, the lumber cut and then floated to mills located down stream. On the west branch of the Clyde River there are a series of old millpond basins, which have now filled in with sediment and are left with an unnatural meander running through them.

The lower half of the west branch contains more mature trees in comparison to the headwater region; remnants of large hemlocks and yellow birch are still prevalent in small pockets today. Where the remnants of mature trees are present, the sections of higher stream quality are also found. The lower half of the west branch seemingly has less channel aggradation, as the substrate is less embedded and contains less fine sediments when compared to the upper reaches in the headwaters area near Colville road. Approximately 600m below the Colville road is when the transition occurs from forest cover, to alder thickets along agriculture fields and carries onward for the remaining stream distance. Excessive sediment deposition has occurred in the reaches along with dense alder growth.

Riparian Management:

- Continue to encourage landowners to leave an appropriate riparian zone, if possible in excess of provincial guidelines
- Plant native tree and shrub species each year within the riparian zone until an Acadian forest mix has been restored

- Initiate alder patch cuts in headwater region to start removing alder thickets, and replacing with native tree/shrub species below and above Colville Road
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts

Restore Degraded Fish Habitats:

- Remove excess brush and debris, being careful to maintain or replace large woody debris and cover for various year classes of salmonids
- Install and maintain a sediment bypass pond at Bill Waller's (old mill pond site) to capture sediment liberated during stream restoration activities and protect downstream habitat. Clean out will occur less frequently as the majority of the sediment is stabilized or removed from upstream reaches. (Potential sediment trap site further up river from Bill W.)
- Install brush mats throughout the watercourse to capture sediment and narrow the stream channel where desired
- Construct / install split logs, digger logs and rock riffles to restore fish cover and diversify habitat once the sediment issue has been resolved
- In-stream channel maintenance at least once every three years (blockage clearing and brushmatting)
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)

Monitoring:

- Carry out an in-stream habitat assessment prior to restoration activities
- Carry out electrofishing surveys to determine juvenile salmonid densities in selected (2) index locations
- Monitor nutrient concentrations and water temperatures during high and low flow (at 2 index sites)
- Monitor the rate of in-filling of all sediment collection traps

g) East Branch Tributary, Clyde River

The east branch of the Clyde River separates off the main river after the third crossing of the Bannockburn road and crosses under Kingston road heading northeastwardly past Willy's Lane. The east branch covers 3.4 km of stream, and has received minimal prior stream enhancement activities. A by-pass pond was installed during 2017 at the end of Willy's Lane. Over the next three years in-stream restoration activities should cover the 1.6km section of river down stream of the Willy's Lane sediment to the main river.

The East branch land usage is predominately agriculture, with minimal forest cover except for a small area below Kingston road.

Riparian Management:

- Encourage farmers to continue with current best management practices, including a 4-year crop rotation
- Plant native tree and shrub species each year in the buffer zone, patch cutting dense alders, taking care not to remove impact on protective grasses adjacent to row crop fields
    - In dense alder thickets, make 30-50m^2 alder patch cuts for plantations. Leave 15-20m between patch cuts

Restore Degraded Fish Habitats:

- Remove excess alders in-stream above Bannockburn road and Kingston road
- Maintain and cleanout the sediment bypass pond upstream at Willy's Lane to prevent future sediment loading downstream
- Downstream of Willy's lane, remove the large woody debris to allow proper flushing of fine sediments and any situations producing excessive bank erosion
- Enhance riffle and run habitat (create interstitial spacing in substrates, remove fine sediments from spawning substrate and create boulder clusters)

Monitoring:

- Carry out an in-stream habitat assessment prior to restoration activities
- Monitor nutrient concentrations and water temperatures during high and low flow (at Kingston road culvert)

List of Sediment Traps for West River

- By-pass pond on Howell's Brook above Peter's Rd (dug out in 2019)
- In-stream trap at Crosby's Pond (dug out in 2018)
- In-stream trap at Carragher's Pond on Quinn's Brook (dug out in 2020)
- By-pass pond on Quinn's Brook at Mill Rd (dug out in 2020)
- By-pass pond at Curley's in Brookvale (dug out in 2019)
- In-stream trap at Ross Rd in Brookvale (dug out in 2020)

List of Sediment Traps for Clyde River

- By-pass pond at Willy's Ln on the east branch (2017)
- By-pass pond at Bill Waller's on the west branch (2018)
- In-stream trap on the main branch on the Dixon's Property (before 2016)

Works Cited

- West River Watershed Management Plan 2008