CAWG Damage and Vulnerability Report:

Assessing the condition of rivers and riparian zones in the North River watershed

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March 27, 2024

Executive Summary

In September of 2022, hurricane Fiona made landfall in Prince Edward Island as the strongest storm in the province's recorded history. Maximum wind speeds of 150kph caused widespread tree fall across PEI, drastically changing the forested landscape. In the aftermath, questions as to the implications of storm damage for the conservation efforts of the Cornwall and Area Watershed Group (CAWG) prompted the launch of a Damage and Vulnerability assessment in the first quarter of 2024, the results of which are the subject of this report.

This widespread walking assessment was first conducted in the North River Watershed, prioritizing survey of salmon rivers due to the nature CAWG goals and funding. Assessment will continue across remaining reaches of the watershed and will be used as an on-going tool to track conditions and priority areas throughout the watershed. Based primarily on the PEI Wildlife Federation's Whole Watershed Rapid Assessment, the survey design allows for quick assessment of river channels and riparian zones at the reach scale which can be easily updated to reflect current conditions any time that a reach is revisited.

The primary goal of this undertaking was to identify areas most impacted by windthrow from the hurricane, areas at greatest risk of future windthrow, areas most impacted erosion and areas at highest risk of erosion. This quantification of degraded areas was accomplished, with the most degraded and at-risk areas being identified and mapped for ongoing reference. An interactive map displaying these results can be viewed at the following URL: https://cawg.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=3681052ac4ee483aaf67fcd467138cb6

Heavy siltation caused by erosion from land use activities was found to be the most prevalent and pressing issue throughout the watershed. Several large areas experiencing severe non-point source erosion were identified, as well as two locations of point-source erosion. These areas should be considered the highest priority for CAWG, and remediation will require large-scale collaboration among several parties. This assessment also identified several areas at high risk of future erosion, which should be the target of preventative restoration efforts and monitoring.

Windthrow was found to be severe across all heavily treed areas in the watershed. However, fallen trees in general serve an important ecological function that was previously minimized in the forests and rivers in the CAWG management area. For this reason, it is recommended that rehabilitation and restoration efforts in the North River watershed should not target the removal of windthrow. The primary concern in these areas should be access, which can be addressed by trail planning and creation as well as the newly developed CAWG Woody Material Management Strategy.

Vulnerability to windthrow is determined by a complex interaction between stand type, structure, topography, wind patterns, tree species, existing trunk damage, water table depth, etc. Because of this complexity, identifying with confidence which tree stands are most vulnerable to future windthrow proved to be beyond the ability of this assessment. Although vulnerability of forest stands could not be quantified, a slight correlation was found between successional stage of stands and severity of windthrow in the North River Watershed. Despite this slight propensity to experience greater levels of windthrow, late-successional stands are by their nature more resilient to disturbances. However, natural disturbances may constitute a threat to at-risk species which are dependent on late-successional forest habitats. It is recommended that following first priorities of fish passage within salmon reaches and access to work sites, damage surveys following future weather disturbances should also focus on late-successional forested areas.

Overall, this assessment served to quantify the extent of storm damage within the watershed, the major issues present in the watershed, and the locations of these issues. In addition to identifying priority areas, this assessment informed the development of a Woody Material Management Strategy designed to take advantage of the recent influx of large wood in local streams to further restoration of important habitat. This information gathered in the course of this assessment will be invaluable to CAWG now and in the coming years, as it will inform site prioritization, seasonal work plans, and decision-making at multiple levels.

Introduction

On-the-ground habitat restoration and rehabilitation work often makes up the bulk of the conservation efforts undertaken by CAWG and similar organizations. When managing habitat restoration at the landscape level, there is great variation in the type of work needed at different locations and which locations require the most attention. In the case of CAWG, the area managed by the organization consists of approximately 11,734 ha of land, 241.78 ha of which makes up legally mandated 15 meter riparian buffer zones, in the North River and Hyde Creek watersheds in Queens's County, Prince Edward Island (PEI). Prioritizing and planning the restoration work for this broad area requires an overall working knowledge of the specific issues present at different locations, as well as the overall issues present within the watershed as a whole.

The riparian landscape in PEI was greatly altered by the effects of hurricane Fiona, which swept through the province in September of 2022. During the 2023 field season, CAWG technicians encountered drastically altered field conditions that made the previously relied-upon schedules and routines difficult to carry out, and in some cases obsolete. The need to re-assess the condition of all parts of the watershed became apparent, as well as the need to determine which projects and areas to prioritize in the upcoming seasons.

To assess the extent of the storm damage and gain a greater understanding of the conditions now present within the various parts of the watershed, a walking assessment of the watershed was launched in the first quarter of 2024, in anticipation of the summer field season. This assessment was carried out with the goals of identifying areas most impacted by windthrow and/or erosion, and areas most likely to suffer from the effects of windthrow or erosion in the future. The project design was based primarily on the Whole Watershed Rapid Assessment created by the PEI Wildlife Federation, with some additions and alterations made to tailor the assessment to the current goals of CAWG.

Methods and Materials

This initial launch of this assessment focused primarily on the ~28 kms of salmon rivers within the North River watershed. These consist of Watts Creek, North River, and Coles Creek. Lack of road access, significant snowfall, and significant windthrow prevented access to some of the more isolated reaches, thus any reaches that could not be accessed are not yet represented in the data. Remaining reaches, including those in other tributaries and streams, such as Warren's Creek, Milton Brook, and Hyde Creek, will be visited throughout the upcoming work season to further expand the collected knowledge about the watershed. Our long-term goal for this project is to maintain an up-to-date database of the conditions present in all reaches of the North River and Hyde Creek watersheds, which will allow us to consistently target priority areas and issues in our work plans.

Initial data collection was conducted throughout January 22 to March 12 of 2024. Survey reaches were accessed by snowshoeing from the closest roads. A crew member walked each reach along the bank observing the characteristics outlined in the data sheets, both within the channel and spanning a distance of 60m on both sides. Satellite imagery was examined to assess some factors that extend beyond the 60m riparian zone, such as upland land use, the extent of high slope in the surrounding area, and potential point-sources for erosion. Immediately after walking each reach, a field data sheet was filled out detailing the characteristics observed within the reach.

Each characteristic observed yielded a score value that when tallied gave a total score for the reach (see Appendix A). Higher scores indicated greater riparian health, while lower scores indicated degraded riparian health. To obtain more specific information, individual criteria were grouped into categories based on their contribution to current erosion, erosion risk, windthrow, and forest stand resilience. Scores for each of these categories were then compared across all reaches.

Current levels of erosion were estimated using scores for bank erosion, presence of gullies, and percentage of siltation in the channel. Risk of future erosion was estimated based on the amount of high sloped land surrounding the channel, the width of the *forested* buffer on each side (note that this is different than the *undisturbed* buffer described in the PEI Water Act Regulations), upland land use, presence of gullies, and presence of invasive jewelweed species. Severity of storm damage was assessed based on the extent of windthrow in the area (derived from both satellite imagery and on-the-ground observations) and number of blockages in the stream. This was compared with forest stand structure and composition in search of relationships that would help predict which stands may be more vulnerable to storm damage in the future.

Results

Erosion

The most pressing issues observed were from current erosion (Fig. 1 and Fig. 2). Significant point-source erosion was found to originate from a shale pit near reach DVCC22, and from cattle access to the stream in reach DVCC12, both on Cole's Creek. Entry points for significant non-point-source erosion were identified in reaches DVCC21 and DVCC09 on Cole's Creek, DVNN03 and DVNN12 on the north branch of North River, and DVWC27 on Watts Creek. Severe non-point source erosion was recorded in multiple reaches (Fig. 3). These represent the lowest erosion health scores, while the reach experiencing the least erosion, DVWC09, had an erosion health score of 18.

Many of the reaches that scored as highest erosion risk were among those found to already be experiencing erosion. Those that are not yet experiencing severe erosion but which remain at highest risk are shown in Fig. 4.

Storm Damage

All forested areas of the watershed experienced storm damage. This had a significant impact on access in the largest forest patches. Despite designing a portion of the assessment with the goal of predicting areas most vulnerable to future windthrow, such predictions could not be made with any certainty from the collected data. A slight positive correlation was found between successional stage and extent of windthrow, with late succession forest stands being more likely to have experienced severe windthrow (Fig. 5).

Figure 1

Locations of significant erosion input and vulnerable old-growth forests.

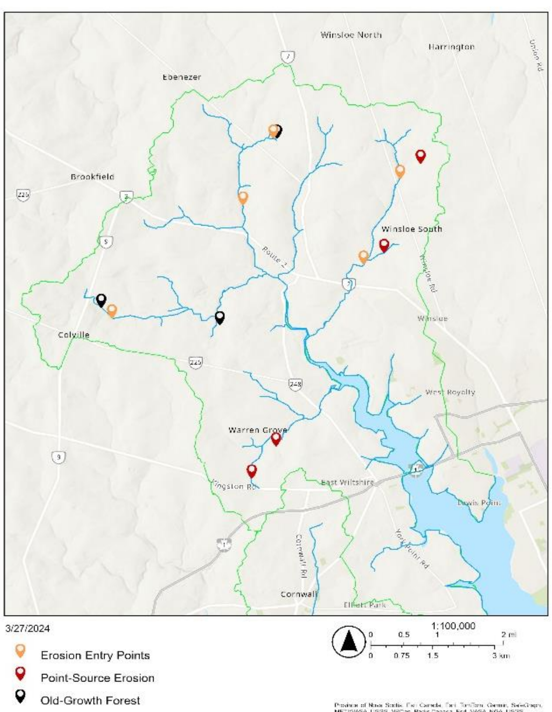


Figure 2

Widespread erosion areas, erosion risk areas, and windthrow areas identified within the North River watershed.

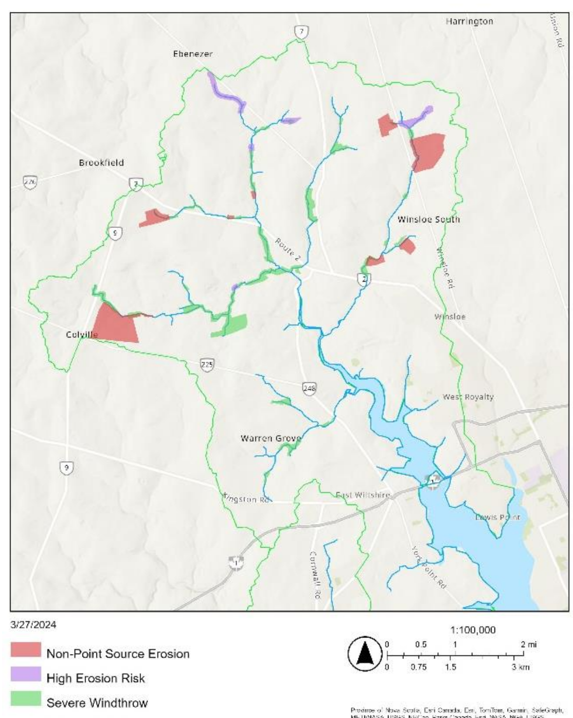


Figure 3

Reaches currently displaying the most severe non-point source erosion problems. Lower scores indicate greater levels of erosion. Only those reaches with the most severe erosion are displayed.

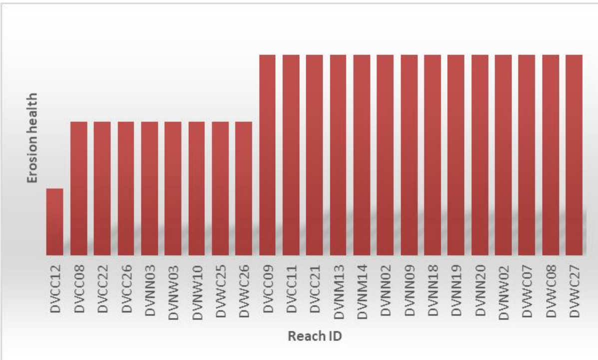


Figure 4

Reaches that are at the highest risk of erosion. Lower scores indicate a higher risk. Only those reaches at greatest risk are displayed.

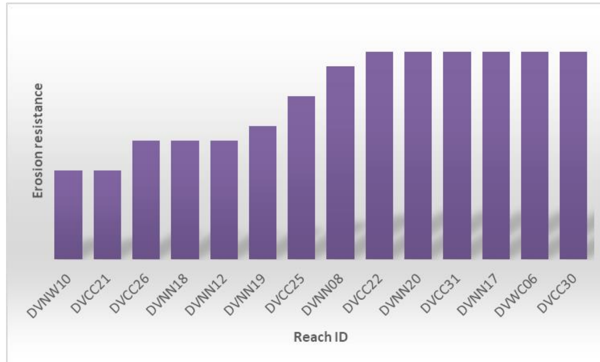
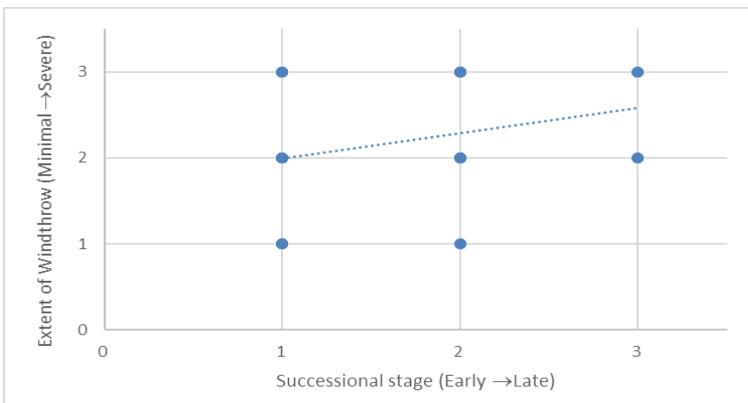


Figure 5

Relationship between successional stage of forest stands and severity of windthrow experienced from hurricane Fiona in the riparian zones of the North River watershed.



Discussion

Although windthrow was found to be extensive throughout CAWG's forested areas, previous and ongoing conditions in the watershed make most removal of fallen trees inadvisable. Drastic visual changes caused to the landscape by hurricane Fiona have led many to view the resulting storm damage as a dire and pressing environmental issue that must be tackled (as evidenced by multiple forms of Fiona response conservation funding established in Prince

Edward Island over the past year). However, both research and observations within the watershed since the storm have shown that it is indeed quite the opposite.

Hurricanes are a form of natural disturbance that are integral to the health of the native Wakanabi/Acadian forest in PEI (Simpson, 2015). Large, downed trees provide important habitat for a variety of insect and animal species. Breaks in the canopy provide opportunities for sun-loving species to colonize, improving the age and species diversity of the stand. As fallen logs dry and decay, they return nutrients to the soil, building the topsoil needed to feed new and continued growth and diversifying the topography of the area. Where swatches of downed trees create large openings in the canopy, the fallen logs function as a bandage for the soil, helping to retain moisture and matter in soil that would otherwise be susceptible to drying and erosion from sun and wind if left exposed.

Fallen wood is equally important in river channels. In riverine habitats, large wood increases fish cover from predators, creates fish rest areas, helps maintain cool temperatures, and increases the diversity of macroinvertebrates, thereby creating more food opportunities for fish (Hafs et al., 2014; NASCO, 2010; Thompson et al., 2018). From a mechanical perspective, wood in rivers influences hydrology, improves stream meander, traps sediment, creates pools, and influences water velocity (Marttila et al., 2018; Wohl & Scott, 2017). The importance of woody material in streams has become a foundation of conservation management in rivers, and the introduction of fallen wood to degraded rivers and streams has proven to be among the most beneficial and effective rehabilitation practices across a wide range of ecosystem types (Thompson et al., 2018; Wohl & Scott, 2017).

Prior to hurricane Fiona, dead wood was lacking in both forest stands and stream reaches throughout watershed. This was the result of a number of converging factors. Extensive agricultural land use in the area has left a very low percentage of forested land, and forests that remain in the area are primarily early-succession stands of low age and species diversity, having been clearcut and occasionally replanted in the past. The enforcement and compliance of buffer-zone maintenance continues to be lacking in heavily agricultural areas of PEI, particularly surrounding headwaters. In past decades, removal of large wood from the local rivers under the mistaken impression that it was ecologically preferable was common, and in subsequent years the input of woody material into the river was limited primarily to the installation of brushmats out of an abundance of caution. Without a healthy supply of dead wood in the landscape, the natural resilience and adaptability of the local freshwater ecosystem was hobbled.

Because fallen wood serves so many important ecological functions, CAWG's management strategy in relation to windthrow should focus primarily on access. There are very few public woodlots and foot trails within CAWG management area, and most that exist are managed by separate entities, so there is no need for CAWG to prioritize public recreational access to wooded areas. Most important is the access of personnel to important work areas, and access of fish to a variety of important habitat types. In response to extant windthrow, CAWG should prioritize the creation of access trails in treed areas where restoration activities may require the on-foot transportation of equipment that cannot be easily transported in the stream. In the rivers, many reaches will benefit from the sediment capturing abilities of increased in-stream woody material. Due to the heavy siltation common in PEI rivers as a result of land use practices, it is recommended that fallen wood be left in the stream as much as possible, except in cases where it may create a barrier to fish passage. In response to the extensive windthrow found in streams during this assessment and the importance of woody material in managing siltation, a woody material management plan has been developed for CAWG and appears in Appendix B of this report.

While windthrow accounts for a much smaller portion of the issues within the watershed than aesthetic sensibilities would suggest, siltation caused by erosion continues to be the prevailing and most problematic issue. The extent of sediment input from surrounding land use was particularly visible during the field portion of this assessment when bare fields and melting snow made the movement of eroded soil across the landscape especially visible. In the past, CAWG addressed this issue primarily via the installation of brushmats, which serve but one of the functions that is served by in-stream woody material in healthy river systems. However, rates of sediment input have outweighed the sediment capturing ability of brushmats in this previously wood-starved system. This assessment has made apparent the need to address issues of sediment input at the source, and the locations currently experiencing high erosion as identified by this assessment should be considered the highest priority for CAWG.

Due to private land ownership and the upland origin of point-source and of non-point source erosion, the aforementioned sites cannot be improved by CAWG field work alone. Remediation in such areas will require collaborative solutions involving landowners, CAWG, and third parties such as PEI's Agri-Watershed Partnership, various provincial tree-planting programs, or in difficult cases, conservation enforcement. Entry-point locations for sediment input may be addressed by tree planting in riparian buffer zones, terracing deadwood in gullies and trenches, and live-staking of weak embankments; however these measures do not constitute long-term solutions on their own and should be followed up by addressing upland erosion issues as previously discussed.

Areas at high risk of future erosion should be considered priority areas for tree planting efforts. Collaboration with landowners is also a necessary component of erosion prevention in these areas. Areas identified as high erosion risk, as well as those identified as experiencing current erosion, should be among the first surveyed for wash-out following future hurricane disturbances.

The results of this assessment, combined with on-the-ground observations, have made clear the most significant conservation issues in the CAWG management area and provided insight into the scale and locations of these issues. Although storm damage is widespread, downed trees only constitute an issue of access and are not a problem from an ecological standpoint. In the rivers particularly, the large amount of fallen trees can be leveraged to speed ecological recovery. Not only does the data gathered in this assessment show that siltation of rivers continues to be the most pressing management issue for CAWG, but it also reveals the precise origins and scale of sediment input which will allow CAWG to more effectively prioritize remediation projects and activities.

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Appendix A

Damage and Vulnerability Assessment Scoring System

CAWG DAMAGE AND VULNERABILITY ASSESSMENT

Reach #: ______________________ **Date:** ______________________
Location: ____
Crew: ____

	Indicator	Measures	Scoring Values	Score
Riparian Zone	1. Is there high sloped land (>9%) surrounding the channel?	No slope	6	
		Slope extends ≤60m from channel	3	
		Slope extends >60m from channel	0	
	2. How many vegetation layers are there on the *right* bank?	3 layers	6	
		2 layers	4	
		1 layer	2	
		Bare ground	0	
	3. How many vegetation layers are there on the *left* bank?	3 layers	6	
		2 layers	4	
		1 layer	2	
		Bare Ground	0	
	4. Plant community composition on *right* bank?	Mature Forest	6	
		Mature forest and alders	5	
		Young forest regen.	4	
		Predominantly alders	2	
		Grasses & weeds	0	
	5. Plant community composition on *left* bank?	Mature forest	6	
		Mature forest and alders	5	
		Young forest regen.	4	
		Predominantly alders	2	
		Grasses and weeds	0	
	6. Width of forested buffer / riparian zone on the *right* bank?	Greater than 45 meters	6	
		45-30 meters	4	
		15-30 meters	2	
		Less than 15 meters	0	
	7. Width of forested buffer / riparian zone on the *left* bank?	Greater than 45 meters	6	
		30-45 meters	4	
		15-30 meters	2	
		Less than 15 meters	0	
	8. Upland land use on the *right* bank?	Mature forest	6	
		Clear-cut regen. / plantation	4	
		Pasture / hayfield / lawn	2	
		Commercial / cult. fields / pit / road	0	
	9. Upland land use on the *left* bank?	Mature forest	6	
		Clear-cut regen / plantation	4	
		Pasture / hayfield / lawn	2	
		Commercial / cult. fields / pit / road	0	
	10. Extent of blow-down	Minimal	6	
		Moderate	2	
		Severe	0	
			Sub-total	
Banks & Channel	11. How much shade is over the stream?	Greater than 75%	6	
		50% - 75%	4	
		25% - 50%	2	
		Less than 25%	0	
	12. How much of the banks are eroding?	Less than 10%	6	
		10% - 20%	4	
		20% - 40%	2	
		More than 40%	0	
	13. Are there gullies on the bank that allow runoff from upland activities?	Gullies absent	6	
		Gullies 1 or more	0	

	14. Have the channel and banks been altered by human activity?	No human activity	6	
		0 – 25%	4	
		25% - 50%	2	
		Greater than 50%	0	
			Sub-total	
Streambed Substrate	15. Primary sediment size class	Boulder	6	
		Cobble	5	
		Gravel	4	
		Sand	2	
		Silt & fines or bedrock	0	
	16. Secondary sediment size class	Boulder	6	
		Cobble	5	
		Gravel	4	
		Sand	2	
		Silt & fines or bedrock	0	
	17. How much of the sediment composition is silt and fines?	0 – 25% silt	6	
		25% - 50% silt	4	
		50% - 75% silt	2	
		Over 75% silt	0	
			Sub-total	
Instream Habitat	18. Number of fish cover / habitat types	Greater than 7 cover types	6	
		5-7 cover types	4	
		2-4 cover types	2	
		Less than 2 cover types	0	
	19. Number of potential barriers to fish passage	None	6	
		1-2 potential barriers	2	
		3 or more potential barriers	0	
	20. Are there springs?	Yes	1	
		No	0	
	21. Are there pools?	Yes	1	
		No	0	
			Sub-total	
Invasive Plant Species	22. Presence of Small-flowered Jewelweed or Himalayan Balsam	None	2	
		Occasional	1	
		Extensive	0	
	23. Presence of Bittersweet nightshade	None	2	
		Occasional	1	
		Extensive	0	
	24. Presence of Woodland Angelica	None	2	
		Occasional	1	
		Extensive	0	
	25. Presence of Japanese Knotweed	None	2	
		Occasional	1	
		Extensive	0	
	26 Presence of Glossy Buckthorn	None	2	
		Occasional	1	
		Extensive	0	
			Subtotal	
			Total Score	
Flow Regime (slow / med/ fast / no flow):				
Comments/Notes:				

CAWG WHOLE WATERSHED DAMAGE AND VULNERABILITY ASSESSMENT
Forest stand resiliency
*Complete this section only for reaches in which there is a treed stand.

Reach #: ____________________ **Date:** ____________________
Location: ____________________
Crew: ____________________

	Indicator	Measure	Score Values	Score
Right bank	1. Age structure of stand?	Mixed age	2	
		Even age	0	
	2. Biodiversity of stand?	Mixed tree species	2	
		Primarily 1-2 species	1	
		Monoculture / plantation	0	
	3. Successional Stage of the stand?	Late-successional	2	
		Mid-successional	1	
		Early-successional	0	
	4. Are the dominant species appropriate to the habitat?	Yes	1	
		No	0	
	5. Are there an unusually high number of sickly trees or snags?	No	1	
		Yes	0	
	6. What percentage of the trees are >10" dbh? (estimate)	0 – 25%	2	
		25% - 50%	1	
		Greater than 50%	0	
			Subtotal:	
	Dominant tree species:			
Left bank	7. Age structure of stand?	Mixed Age	1	
		Even Age	0	
	8. Biodiversity of stand?	Mixed tree species	2	
		Primarily 1-2 species	1	
		Monoculture / plantation	0	
	9. Successional stage of the stand?	Late-successional	2	
		Mid-successional	1	
		Early-successional	0	
	10. Are the dominant species appropriate to the habitat?	Yes	1	
		No	0	
	11. Are there an unusually high number or sickly trees or snags?	No	1	
		Yes	0	
	12. What percentage of the trees are >10" dbh? (estimate)	0 – 25%	2	
		25% - 50%	1	
		Greater than 50%	0	
			Subtotal:	
	Dominant tree species:			
			Total:	

Notes: (e.g. extent of blowdown)

Appendix B

CAWG Woody Material Management Strategy

Introduction

In Prince Edward Island, one of the primary mandates of many community-based watershed groups is the improvement of salmonid habitat in local rivers. Armstrong et al., 2003; Committee on the Status of Endangered Wildlife in Canada., 2011; Mollenhauer et al., 2013; NASCO, 2010; and Raleigh et al., 1984, all explain that salmonids make use of a variety of different habitat types depending on age, species, and season. They further describe salmonid habitat requirements, which include riffles with a gravel or cobble substrate for breeding habitat, cool, clear water of moderate velocity and depth, deep and lower-velocity pools for resting and refuge, in-stream cover for protection from sun and predators, organic materials to support fish foraging opportunities, and well-connected streams that allow access to a wide variety of these habitat types for foraging and cover.

In healthy salmonid rivers, these requirements are maintained and controlled by a forested riparian zone which, among other functions, **provides an input of woody material into the stream**. Functions of large wood in streams includes:

- Improved sediment deposition and storage (Marttila et al., 2018; Wohl & Scott, 2017),
- Increased volume in pools (Wohl & Scott, 2017), and
- Improved biotic production and increase to fish foraging habitat (Hafs et al., 2014; Thompson et al., 2018).

Wood in streams also increases the amount of in-stream cover available to fish and is commonly used in conservation efforts to rebuild or protect riverbanks.

Within the North River and Hyde Creek watersheds, which is the management area of the Cornwall and Area Watershed Group (CAWG), habitat degradation is widespread and primarily related to surrounding land use practices which allow a large volume of sediment run-off into the streams. These same practices further compound the issue by reducing canopy cover, interfering with the natural meander of the stream, reducing connectivity to the floodplain, homogenizing vertical profile of the stream, and increasing nutrient and pesticide loading.

It should be noted that many of the most commonly studied functions of in-stream woody material relate to sediment storage and transport. Because of the ongoing problems with siltation in CAWG rivers, and because the presence of woody material has a substantial influence on sediment movement within the stream, management of in-stream woody material in the CAWG management area is a delicate balance between encouraging sediment storage and encouraging sediment transport. A strong understanding of stream hydrology, in-stream sediment movement, salmonid habitat requirements, and the relationship between these factors and stream order is needed to successfully walk this line.

In an event that should prove beneficial for the river systems under CAWG management, extensive windthrow caused hurricane Fiona when it struck PEI in 2022 resulted in a massive influx to in-stream woody material in river systems throughout the province. Although this may appear at first glance to constitute a challenge to fish passage, this natural increase to large wood in local river systems has the potential to help speed habitat rehabilitation. The management strategy described below is designed in the context of the recent hurricane disturbance and aims to maximize the potential of existing in-stream woody material. It is recommended that this strategy be reviewed and updated in future years as conditions fluctuate.

Management strategy

Management of in-stream woody materials for the purpose of reducing siltation of salmonid spawning beds requires a two-pronged approach. Sediment transport should be encouraged over spawning beds specifically, and sediment storage should be encouraged along banks and point bars. If this is done well, improvements can be expected to fish habitat, natural stream meander, and sediment storage along banks and floodplains.

In the fields of river conservation and hydrology, river reaches are classified by order. First order streams are the uppermost tributaries and headwaters. The order number increases downstream at each point where two tributaries of the *same order* meet. With increasing order we can expect to see differences in habitat, scale, and surrounding land use. Fish will inhabit different sections of the river at different times depending on their seasonal habitat requirements. It has also been observed within the CAWG management area that treed buffer zones tend to be better retained along second and third order reaches, as opposed to headwaters and estuaries. For these reasons, this woody material management assigns goals and specific strategies based on stream order. Using the following classifications as a guide, the recommended strategies should be applied at the discretion of management personnel based on stream order and the specific conditions found within individual reaches.

First order streams and headwaters

First order streams and headwaters are often refuges for trout during hot weather because they contain cool, spring-fed water. In the CAWG management area, most of the land surrounding headwaters tends to be heavily farmed, with reduced buffer zones that lack trees and shrubs. This means that these headwaters have little protection from the sun, receive little natural large wood input, and typically experience high levels of sediment input, all of which has resulted in severe degradation. These reaches will therefore benefit greatly to the recent increase of in-stream woody material. Although many headwaters are degraded, most tributaries in the North River system do have one or more first order streams with a healthy tree buffer. Fish passage can be made most available to these healthier reaches via appropriate woody material management.

Goals:

- Improve storage of sediment and prevent sediment from being transported further downstream.
- Improve in-stream shade and cover.
- Increase habitat variability.
- Ensure fish access to cool, high-quality habitat.

Strategies:

- Leave all in-stream wood at headwaters.
- Leave all in-stream large wood in first order streams that are lacking a treed buffer.
- Optionally, add large wood to first order streams and headwaters where it is lacking, especially where the absence of a treed buffer has left the stream exposed and/or caused degradation.
- Remove barriers to fish passage in selected first order streams that are already surrounded by an intact treed buffer. Remove only as much wood as is necessary to ensure passage and leave all wood that does not constitute a barrier.

Second and third order streams

A significant amount of salmonid spawning and feeding habitat in the North River system is found within the second and third order streams. These reaches are most likely to have appropriate salmonid spawning habitat. Siltation of spawning beds is the greatest issue in these reaches. Although much of the silt in these reaches is transported from the headwaters, there is also a significant amount of direct sediment input to second order streams in areas with upland commercial farm fields and/or areas where the treed buffer is inadequate. Management of these reaches can be complex, because while it is important to prevent and remediate the siltation of spawning beds, it is also important encourage sediment storage and prevent silt from being transported further downstream. Some of these reaches may also require relief from bank erosion, or support to the natural meander of the stream.

Goals:

- Decrease siltation of spawning beds.
- Reduce sediment transport to downstream reaches.
- Increase habitat variability.

Strategies:

- Remove barriers to fish passage in the thalweg.
- Leave all woody material outside of the thalweg, except where it may be causing over-widening of the stream or erosion of the bank.
- Install brushmats on degraded point bars.
- Where bank erosion is extreme, deflector logs may be placed strategically to protect the bank.

Fourth order streams

Most rivers in Prince Edward Island are third order at the mouth. North River is one of the exceptions, reaching fourth order at “the Forks,” where Watts Creek joins North River. The section of North river just below this point (from “the Forks” downstream to Milton Bridge) is degraded from heavy siltation, over-straightening, and lack of fish cover. Nonetheless, salmonid redds are routinely found in the upper section.

Goals:

- Decrease siltation of spawning beds.
- Improve the natural meander of the river.
- Increase fish cover.
- Increase habitat variability.

Strategies:

- Leave all in-stream wood, except where it may constitute a barrier to fish passage.
- Where necessary, move or add large wood just above spawning beds to create slight pinch points and encourage sediment transport over the spawning beds.
- Where necessary, move or add large wood just below spawning beds to encourage pool formation.
- Following the meander of the thalweg as a guide, add large wood as deflectors at various points along the wetted edges of the river to improve the natural meander of the stream and increase habitat variability.

Further Considerations

In applying this strategy, it is important above all to take advantage of the large wood already present in the streams, and to make changes conservatively. Many of the problems present in the rivers managed by CAWG have been exacerbated in the past by removal of wood from the channel and riparian zones to extents far beyond the abilities of CAWG to replace. Concerns regarding barriers to fish passage or channel morphology should not take precedence over the retention of in-stream large wood, because the presence of this wood has the ability to re-ignite and maintain the ecological and geomorphic processes that naturally prevent or correct such problems.

It is recommended to begin at the mouths of tributaries and work in an upstream direction, both for the ease of the crew and so that increases to downstream velocity are slow and incremental. There may occasionally be re-establishment of log jams downstream as wood is mobilized, and these should be addressed using the same principles that were used in the first pass. Routine monitoring of reaches following the application of woody material management will be necessary, and observed changes should be recorded to aid in future decision-making.

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