Broken Brooks 2012

Salmonidae Outreach, Accessibility and Restoration

By Kristen Wagner
Fish Habitat Technician
January 2013

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Funded in part by Nova Scotia Salmon Association's Adopt A Stream Program, RBC Blue Water Project, Human Resource Skills Development Canada: Career Focus Internship and Nova Scotia Transportation and Infrastructure Renewal

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Acknowledgements

The Broken Brooks project would not have been possible without the financial support of the Nova Scotia Salmon Association's NSLC Adopt A Stream program, RBC Blue Water Project, Human Resource Skills Development Canada: Career Focus Internship and Nova Scotia Transportation and Infrastructure Renewal.

Thank you to Amy Weston (Program Manager) and Bob Rutherford (Committee Chair) of NSLC Adopt A Stream for your ongoing project support, protocol reviews and guidance.

To Wil Brunner (Clean Nova Scotia), thank you for providing guidance and support for the Nova Scotia Fish Habitat Assessment Protocol and being available to answer any questions and for providing continued project support.

To Oliver Woods (Saint Mary's University), thank you for your continued technical support throughout this entire project.

Thank you to the entire Clean Annapolis River Project, without all of your help and support, Broken Brooks would not have been a success. To Monik Richard (Executive Director), Levi Cliche (Manager of Program Delivery) and Susan Lane (Administrative Manager) for all of the in-office support and management you provided. To summer staff Alexander Simon, Jenna Pentz, Marissa Murphy and Beth Stevens, your dedication in completing culvert assessments was greatly appreciated. To the rest of the CARP staff – Jeff Medicraft, Jamie McCamon, Lindsey Freeman and Carolyn Hann, for all of your extra help in the field and for all of your help and advice in the office. And finally, a big thank you to Earl Acker, CARP's Volunteer of the Year for his hard work with restorations.

CARP would like to acknowledge the contribution of the Economic and Social Research Group's (ESRI) contribution of ArcGIS software through the ESRI Conservation Program. The creation of the maps included in this report were made possible by this contribution.

Executive Summary

Habitat fragmentation caused by barrier culverts can impede the upstream and downstream movements of fish through a stream system. Insufficient water depths, incorrect sizing, steep slopes and large outflow drops are just a few of several problems that can characterize a culvert as a barrier. When fish migration is restricted in a stream, it can have a negative impact on the success of fish populations.

Culverts were categorized as being fully passable, partial, or full barriers based on the criteria for a target species adapted from Nova Scotia Environment (NSE), Department of Fisheries and Oceans (DFO) and Terra Nova National Park protocols. The target species was brook trout of 5 cm length and greater. Brook trout are a native fish species to Nova Scotia, found in freshwater streams and lakes. Once a culvert was identified as a barrier, remediation options were considered and barrier culverts were prioritized for remediation.

Broken Brooks was initiated in 2007 by Clean Annapolis River Project (CARP) to assess aquatic habitat connectivity within the Annapolis River watershed. Through the first 3 field season, (2007, 2010 and 2011), 1,273 sites have been visited and 300 detailed culvert assessments have been completed within the greater watershed.

During the 2012 field season, a more refined approach was used; culvert assessments were focused within specific and entire sub-watersheds, rather than across the greater Annapolis River watershed. Throughout July and August, CARP visited 81 sites within the Black River and Nictaux River sub-watersheds. Of the sites visited, 46 were culverts on fish-bearing streams and received detailed assessments. Based on the data collected, 37 (80%) of the culverts assessed do not meet the current provincial guidelines, classifying them as barriers.

Remediations were completed at 12 sites; 5 debris removals within the Black River sub-watershed, 6 debris removals within the Nictaux River sub-watershed, and modifications were made to a rock weir installed in 2011 on Troop Brook.

In addition to the culvert assessments, fish population surveys and habitat suitability assessments were completed at sites within the Black River sub-watershed, to determine whether this system is of suitable habitat for Atlantic salmon; the beginning stages for the development of an Atlantic salmon sub-watershed habitat restoration management plan.

1.0 Introduction

Habitat fragmentation of aquatic ecosystems due to barrier culverts, barrier bridges or dams can threaten the success of many aquatic species. Culverts are designed to allow water to flow under roads and railbeds; however if they are improperly installed, or if they do not receive regular maintenance, they can become barriers to fish passage. Many species of fish migrate through stream systems in search of favourable habitats for spawning, feeding, overwintering and thermal refuge in order to successfully complete the different stages of their life cycles. The loss of access to these various habitats can have a severely negative impact on both the reproductive and overall success of a population. For example, brook trout inhabit cool water stream systems; however, they will migrate through the system in search of cooler water in the summer months when water temperatures rise. If barrier culverts exist along their migration route, they will be unable to access thermal refuge.

The hydrological features of a stream and the surrounding watershed must be taken into consideration during the planning stages of culvert installation in order to minimize the chance of the culvert becoming a barrier. There are a number of characteristics that can render a culvert impassable to fish. Insufficient water depth in the culvert, improper size, high water velocity, steep slope, large outflow drop and debris build up are some of the most common issues with culverts being barriers to fish passage.

The culvert assessment protocol was adapted from a variety of sources throughout Canada and the United States, and then modified to accomodate the capabilities of a non-governmental organization. Over the past field seasons, the protocol has been adjusted to improve data collection. The data collected for each culvert was analyzed against two sets of criteria to determine whether it was passable or a barrier to fish passage. The first set of criteria was set out by Nova Scotia Environment (NSE) and the Department of Fisheries and Oceans (DFO). According to the current guidelines, a culvert should be installed with a slope that is less than 0.5%, it should also be embedded at a depth of 0.4D, where D is the height of the culvert (Savoie and Haché 2002). If a culvert fails to meet this slope criterion, then the culvert must be installed with baffles to aid in fish passage.

Any culvert that is identified as a non-barrier culvert meets the provincial guidelines. Culverts that do not meet these guidelines were further classified into partial or full barrier to fish passage for the purpose of prioritizing them for remediation,. This further classification methodology is based on that developed in part by Terra Nova National Park, Newfoundland, and allows for a greater outflow drop. Culvert slope and outflow drop are divided into three distinct categories, used in relation to a given target species, to determine barrier type (Coté 2009). A culvert with a slope less than 0.5% and an outflow drop less than one body length of the target species is considered to be fully passable.

The target species for the 2012 field season was a brook trout (*Salvelinus fontinalis*), 5 cm in size or greater. This is a smaller sized target species than what had been used in previous years; however, it accounts for a wider range of age classes and swimming abilities that are found within these streams.

Broken Brooks was initiated in 2007, and continued through the 2010, 2011 and 2012 field seasons, with the purpose of assessing and restoring aquatic connectivity within the Annapolis River watershed. Previously, road-watercourse crossings along the main stem of the Annapolis River throughout the greater watershed were the focus for the project. In 2012, the focus shifted to assessing aquatic connectivity within sub-watersheds, to allow for the characterization of an entire sub-system. The data collected from culvert assessments, along with water and habitat quality assessments and fish population surveys, contributed to the development of a sub-watershed habitat restoration management plan for Atlantic salmon.

2.0 Methodology

The protocol for assessing culverts for fish passage was adapted from the Nova Scotia Environment provincial guidelines (to determine non-barrier culverts) and from protocols developed by British Columbia Ministry of Environment (Parker 2000), Terra Nova National Park (Coté 2009), U.S. Department of Agriculture, Forest Service, National Technology and Development Program (Clarkin 2005), and the Department of Fisheries and Oceans Canada (DFO 2007) (to further assess barrier culverts). The protocol was then modified to suit the needs and meet the capabilities of Clean Annapolis River Project (CARP), as well as comply with the requirements for FishXing, a computer simulation software program that analyzes inputted data to determine if a culvert is passable for fish. Although FishXing was not used to analyze the culvert data in the past, by collecting the required data for FishXing, more detailed fish passage assessments can be completed in the future if required.

There were 3 main components of the assessment process:

1. Identifying and prioritizing watercourse crossings
2. Site assessments
3. Data collection
4. Prioritizing barriers for remediation

2.1 Identifying and Prioritizing Watercourse Crossings

In 2006, ArcGIS was used to identify 1615 potential road-watercourse crossings were within the Annapolis River watershed by Andrea Coombs of Saint Mary's University (Figure 1). After the completion of 4 field seasons, 1354 sites have been visited, and 344 detailed assessments were completed. Refer to Table 1 for the breakdown of sites visited and detail assessments completed for each field season.

Figure 1. Identified road-watercourse crossings in the Annapolis River watershed by Andrea Coombs in 2006.

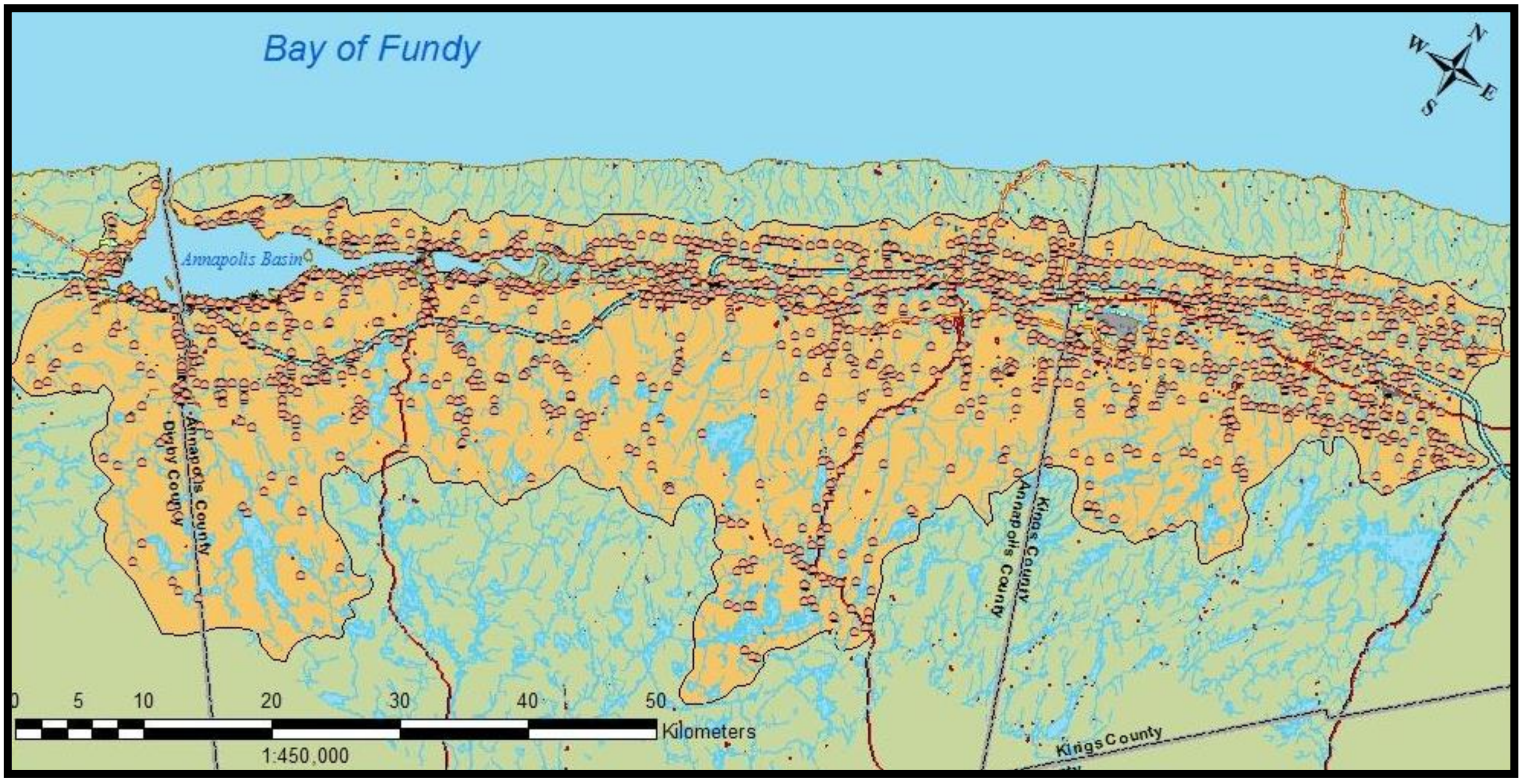

Table 1. Field season-specific breakdown of sites visited and detailed assessments completed during 4 field seasons of *Broken Brooks*.

Field Season	Number of Sites Visited	Number of Detailed Assessments
2007	268	60
2010	777	158
2011	228	82
2012	81	47
Total	**1354**	**347**

2.2 Site Assessments

During the 2012 field season, culvert assessments were focused within the Black River (Figure 2) and Nictaux River sub-watersheds (Figure 3). The road-watercourse crossings identified in 2006 were the starting point for locating culverts within the two sub-watersheds. UTM coordinates were uploaded to a GPS to assist with locating the culverts.

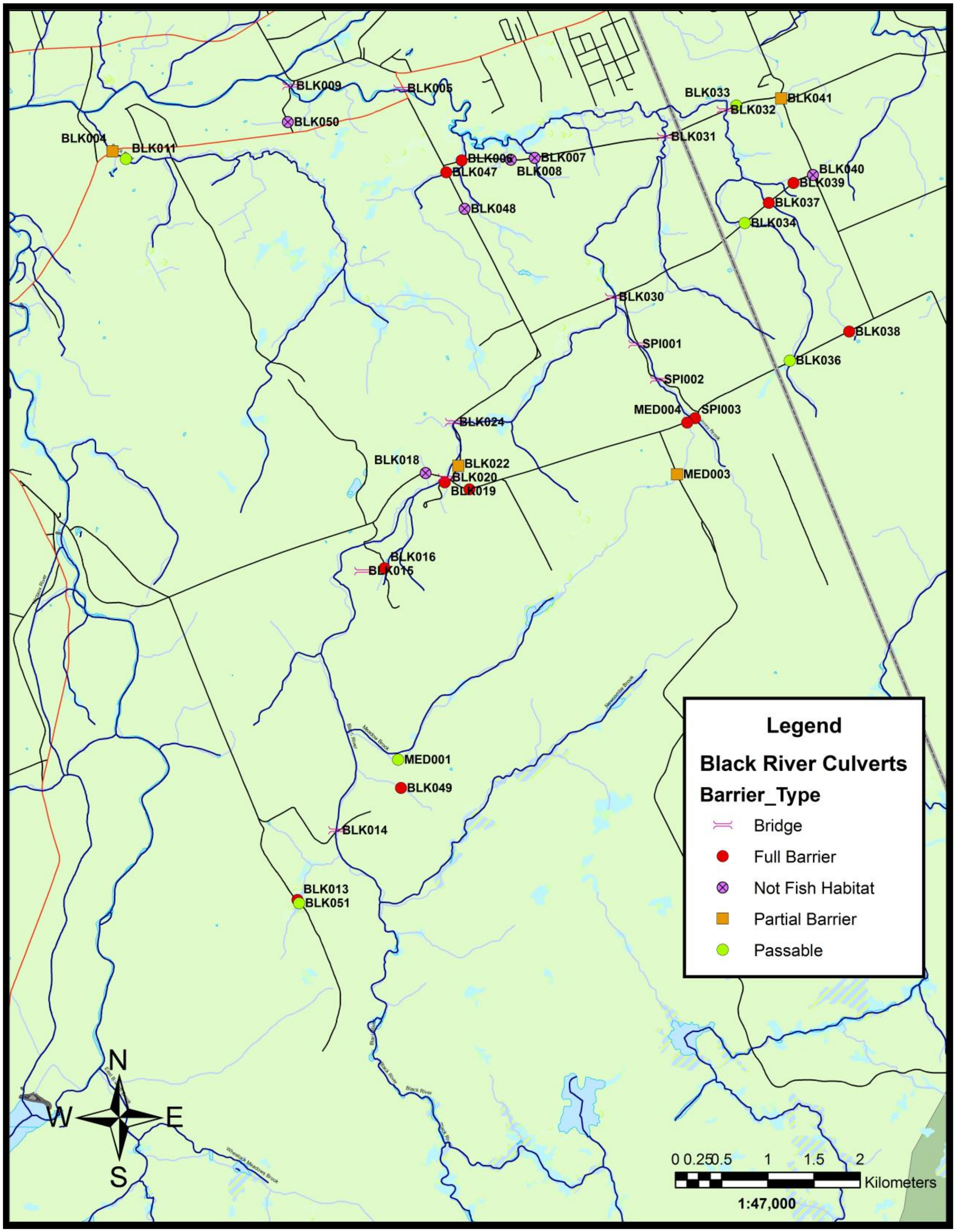

Figure 2. Watercourse crossings visited within the Black River sub-watershed.

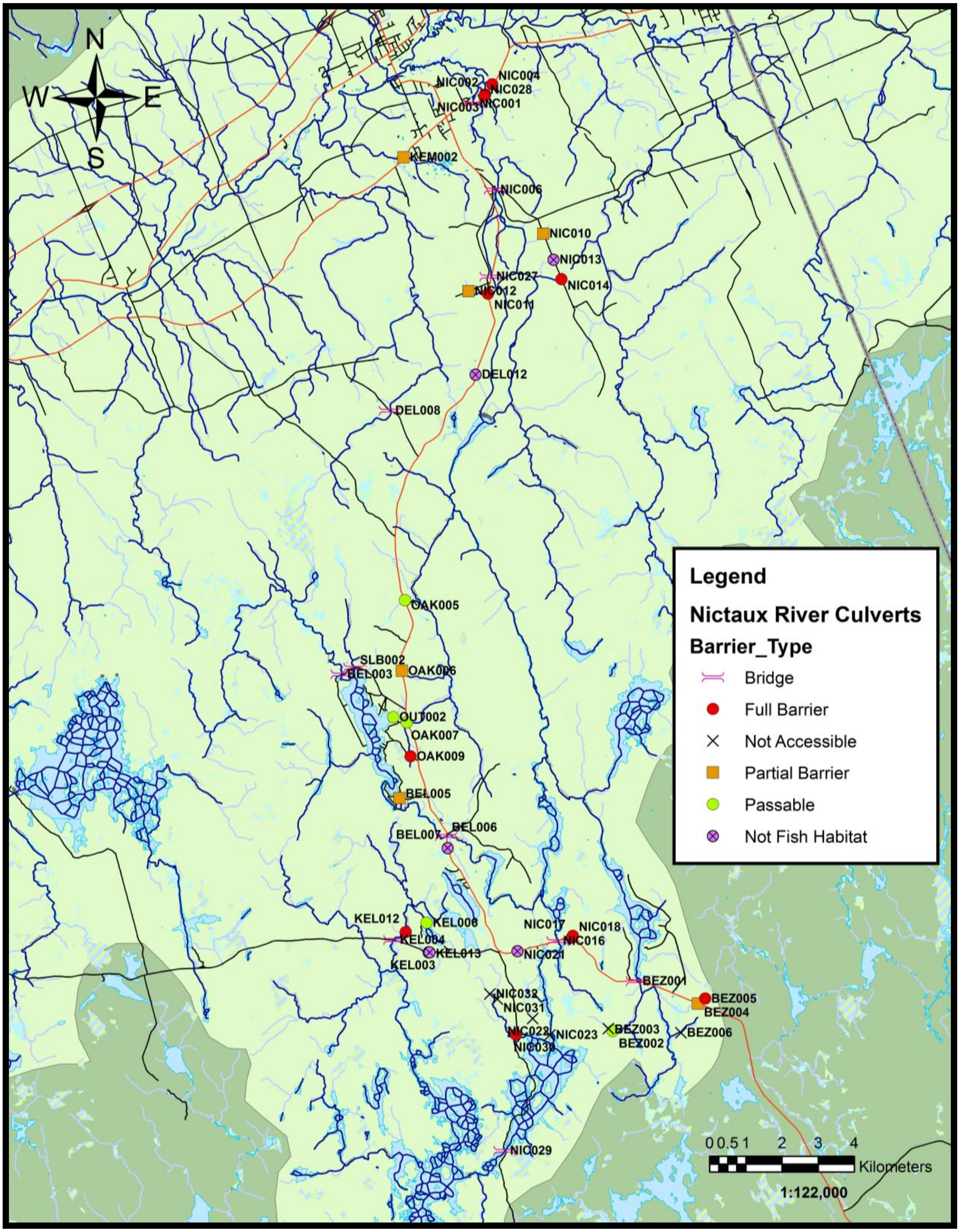

Figure 3. Watercourse crossings visited within the Nictaux River sub-watershed.

2.3 Data Collection

Upon arrival at each road-watercourse crossing site, it was first determined whether the culvert required a detailed assessment. If the culvert was on a stream with potential fish habitat, a detailed assessment was completed; if the culvert was not located within potential fish habitat, such as a drainage ditch, no information was collected. For our purposes a potential fish habitat was used as a synonym for a natural watercourse. Some of the information gathered at each site included the size and shape of the culvert, as well as the material it was made of. Wetted and bankfull stream widths were taken at a pool, riffle and run upstream of the culvert. Survey equipment was used to take elevation measurements that were used to calculate the upstream and downstream channel slope, the culvert slope, outflow drop and to create a profile at the tailwater control downstream of the culvert. Additionally, water quality readings were taken at every site that had sufficient water flowing through the culvert, using a YSI Professional Plus (Model: Pro10102030). For a more detailed field assessment procedure and a full equipment list, refer to *A Guide to Surveying Culverts for Fish Passage* (Taylor 2011).

The criteria used to determine whether a culvert is passable or if it impedes fish passage were modified for the 2012 field season. Previously, when road-watercourse sites were visited, if a culvert had a natural bottom, or was 100% backwatered at the time of assessment, it was deemed as being completely passable, and no further information was collected. Detailed assessments were only completed on culverts that did not meet either of the criteria. This only took environmental conditions at the time of assessment into account. Environmental conditions can change from day to day, and thus it may not be an accurate method of identifying all barriers present. As a way to improve data collection, the protocol for classifying barriers was modified – detailed assessments were completed on all culvert that were found on fish bearing streams, regardless of whether it appeared to be passable at the time of assessment. Classification was then based on culvert slope and outflow drop, allowing for more detailed information to be collected, as well as to account for variations in the weather, such as periods of low flow, when there may no be adequate levels of water in culverts to allow fish passage.

Culverts were placed into one of three categories – non barrier, partial barrier, or full barrier. The criteria for each category were set for the target species, brook trout of 5 cm or greater. Refer to Table 2 for a breakdown of the barrier classification system.

Table 2. Barrier type and criteria for determining fish passage.

	Barrier Type	Criteria
Meets Provincial Guidelines	**Non-Barrier**	Both of the following criteria must be met: • Outflow drop < 1 body length of target species • Culvert slope < 0.5%
Does Not Meet Provincial Guidelines	**Partial Barrier**	At least one of the following criteria must be met: • Outflow drop between 1 – 2 body lengths of the target species • Culvert slope between 0.5% - 2.5%
	Full Barrier	At least one of the following criteria must be met: • Outflow drop > 2 body lengths of the target species • Culvert slope > 2.5%

All collected data was compiled into an Excel spreadsheet. ArcGIS was used to create maps of the Black River and Nictaux River sub-watersheds to show all road-watercourse crossings that were visited throughout the field season, and to show their barrier classification.

2.4 Prioritizing Barriers for Remediation

Once the barrier type was determined for each culvert, the next step involved determining the remediation options available for each barrier culvert (Table 3). The remediation options that are listed below are not the only options that are available; however, they are among the most common remediations that are completed. The criteria used for determining the remediation option were taken from guidelines that were created by British Columbia Ministry of Environment (BC Ministry of Environment 2008).

Table 3. Barrier culvert remediation options for culverts that do not meet provincial guidelines.

Barrier Type	Remediation Option	Criteria
Partial Barrier	Debris removal	• No outflow drop • Slope < 0.5% • Debris obstructing inflow or outflow
	Channel roughening	• No outflow drop • Slope < 1.0%
	Tailwater control	• Outflow drop < 30 cm • Slope < 2.0%
	Baffle installation	• Outflow drop < 1 body length of target species • Slope ≥ 2.5%
Full Barrier	Baffle installation and tailwater control	• Outflow drop < 30 cm • Slope ≥ 2.5%
	Removal of structure/ fish ladder	• Outflow drop > 30 cm • Slope ≥ 7.0%

After the remediation option for each barrier culvert was established, the culverts were then prioritized for remediation. High priority culverts are those that gain the greatest benefit from remediation. There are three key variables considered during the prioritization process:

1. Number of downstream barriers – Barriers downstream can reduce a fish's chance of migrating between the main channel and the watercourse.

2. Adjacency to main channel – The location of a road-watercourse crossing relative to the main watershed channel is important to fish migration. If a barrier is present at the first crossing on a watercourse, then valuable upstream habitat is lost. The first road-watercourse crossing located near the mouth of a tributary and the main stem of a river scores 5 in the prioritization chart, while all other crossings receive 0.

3. Upstream habitat gain – If the barrier at a road-watercourse crossing were to be remediated, this is the estimated quantity of upstream habitat that would be gained.

The three variables were subdivided into categories, each with a corresponding score (Table 4). The culvert with the highest cumulative score was deemed to be the highest priority culvert.

Table 4. Road-watercourse crossing prioritization index.

Variable	Criterion	Score
Number of downstream barriers	0 barriers	10
	1 barrier	5
	> 2 barriers	0
Adjacent to main channel	Yes	5
	No	0
Upstream habitat gain	>4.5 km	20
	4 – 4.5 km	18
	3.5 – 4 km	15
	3 – 3.5 km	14
	2.5 – 3 km	12
	2 – 2.5 km	10
	1.5 – 2 km	8
	1 – 1.5 km	6
	0.5 – 1 km	4
	< 0.5 km	2

3.0 Results

In 2012, culvert assessments began on July 12, 2012 and continued through until August 20, 2012. Eighty-one potential road-watercourse crossings were visited within the Black River and Nictaux River sub-watersheds. Of the 81 sites visited, 46 sites (57%) were culverts located on fish-bearing streams, 23 sites (28%) were bridges and the remaining 12 sites (15%) were culverts on non-fish-bearing streams (Table 3). See Appendix D for a full list of culverts assessed.

Table 5. Road-watercourse crossings in the Black River and Nictaux River sub-watersheds.

Watercourse Crossing Type	Count	Percent (%)
Culvert	46	57
Bridge	23	28
Not Fish Habitat	12	15
Total	**81**	**100**

In total, 9 of the culverts found on fish-bearing streams were passable (20%), leaving 37 culverts (80%) as partial or full barriers (Table 4). This is a significant increase in the proportion of barrier culverts when compared to previous field seasons where 55%, 55% and 57% of culverts on fish-bearing streams were found in 2007, 2010 and 2011 respectively (Table 5)

Table 6. Culvert assessment results for 2012.

Meets Provincial Guidelines	Culvert Type	Count	Percent (%)
Yes	Non-Barrier	9	20
No	Partial Barrier	9	20
No	Full Barrier	28	60
	Total	**46**	**100**

Table 7. Total number of barrier culverts by year.

Year	Number of Culverts Assessed	Number of Barrier Culverts	Percent (%)
2007	60	33	55
2010	516	285	55
2011	144	82	57
2012	46	37	80

The increase in the number of barriers noted in 2012 may be caused by two factors. First, the size of the target species decreased from 10 cm to 5 cm for the 2012 field season. By doing this, the maximum allowable outflow drop for a passable culvert is reduced. Thus, culverts that may have been passable for a 10 cm fish may be recognized as a full or partial barrier for a 5 cm fish. Secondly, by completing detailed assessments on all of the culverts that are found on fish-bearing streams, more barriers are likely to be identified. This will be due to barrier classification being based on outflow drop and culvert slope, rather than on the environmental conditions at the time of assessment.

For most of the barrier culverts, there was more than one issue contributing to the restriction of fish passage. The most common issues with culverts were outflow drop and slope. Remediation option for each barrier culvert was established (Table 8). Refer to Appendix D for the outflow drop and culvert slope values as well as more details for each structure.

Table 8. Barrier culverts, problems and recommended fixes.

Structure ID	Watercourse Name	Road Name	Northing	Easting	Problem	Recommended Fix
BLK004	Black River	HWY 201	340265	4978857	Slope	Tailwater control
BLK006	Black River	Meadowvale Rd	344041	4978760	Outflow drop	Removal of structure
BLK039	Black River	Messenger Rd	347630	4978515	Outflow drop Slope	Removal of structure
BLK037	Black River	Messenger Rd	347362	4978300	Outflow drop Slope	Removal of structure
BLK047	Black River	Torbrook Rd	343873	4978631	Debris Outflow drop Slope	Debris removal; tailwater control
BLK038	Black River	E Torbrook Rd	348232	4976907	Outflow drop Slope	Removal of structure
SPI003	Spinney Mountain Brook	E Torbrook Rd	346566	4975970	Outflow drop Slope	Removal of structure
BLK021	Black River	E Torbrook Rd	344123	4975200	Outflow drop	Removal of structure
BLK019	Black River	Whitman Br	343858	4875276	Debris	Debris removal
BLK022	Black River	Torbrook Rd	344004	4975456	Rock Debris Slope	Debris removal; baffle installation and tailwater control
MED001	Meadow Brook	Off Allen Lake Rd	343352	4972275	Debris	Debris removal
MED004	Meadow Brook	E Torbrook Rd	346480	4975922	Outflow drop Slope	Removal of structure
MED003	Meadow Brook	Fire Lane	346371	4975363	Slope	Tailwater control
BLK016	Black River	Uhlman Br	343205	4974348	Outflow drop Slope	Removal of structure
BLK049	Black River	Allen Lake Rd	343383	4971969	Outflow drop Slope	Baffle installation and tailwater control
BLK013	Black River	Bloomington Rd	342263	4970757	Debris	Debris removal
BLK051	Black River	Bloomington Rd	342281	4970723	Debris	Debris removal
BLK041	Black River	Remont Rd	347497	4979430	Slope	Tailwater control
NIC004	Nictaux River	HWY 201	339624	4977744	Outflow drop Slope	Removal of structure
NIC003	Nictaux River	HWY 201	339426	4977464	Debris Outflow drop Slope	Debris removal; baffle installation and tailwater control
NIC002	Nictaux River	HWY 201	339410	4977432	Debris	Debris removal;

					Slope Velocity*	tailwater control
NIC028	Nictaux River	HWY 201	339403	4977420	Debris Outflow drop	Debris removal
NIC010	Nictaux River	Bloomington Rd	341031	4973625	Debris Slope	Debris removal; tailwater control
NIC014	Nictaux River	Bloomington Rd	341534	4972368	Outflow drop	Tailwater control
NIC011	Nictaux River	HWY 10	339506	4971966	Outflow drop Slope	Removal of structure
NIC012	Nictaux River	Neily Rd	338968	4972040	Debris	Debris removal
KEM002	Kempt Brook	HWY 201	337170	4975730	Slope	Tailwater control
BEZ004	Bezant Lake Brook	HWY 10	345302	4952378	Outflow drop	Tailwater control
BEZ005	Bezant Lake Brook	Off HWY 10	345507	4952516	Debris	Debris removal
NIC017	Nictaux River	HWY 10	341824	4954199	Debris	Debris removal
NIC018	Nictaux River	Off HWY 10	341850	4954251	Slope	Culvert is collapsed – reinstall
NIC024	Nictaux River	Off Old Liverpool Rd	339416	4945770	Debris Outflow drop	Debris removal; tailwater control
NIC030	Nictaux River	Old Liverpool Rd	340273	4951524	Debris	Debris removal
OAK009	Oakes Brook	Adam's Rd	337365	4959200	Outflow drop Slope	Removal of structure
BEL005	Beals Brook	Eves Rd	337060	4958051	Outflow drop	Tailwater control
OAK006	Oakes Brook	HWY 10	337128	4961560	Slope	Tailwater control
KEL012	Kelly Brook	West Dalhousie Rd	337233	4954353	Slope	Removal of Structure

One method of prioritizing assessed culverts was based on was the amount of upstream habitat available beyond the barrier culvert (Table 9). Low priority culverts had less than 500 m of upstream habitat available, medium priority culverts had between 500 and 1000 m of upstream habitat and high priority culverts were those with over 1000 m (1 km) of available upstream habitat. Upstream habitat was measured using the ruler tool on ArcMap 9.3.1, and was measured from the culvert upstream to the next barrier culvert on the watercourse. The majority of partial and full barrier culverts, 56% and 46%, respectively, are classified as low priority. These high numbers may be due to the fact that there are a significant number of partial and full barriers within the Black River and Nictaux River sub-watersheds; some are found in succession, with little stream between them, and others are found close to the headwaters. See Appendix E for a list of high priority culverts, Appendix F for medium priority culverts and Appendix G for low priority culverts.

Table 9. Prioritization of culverts (Low – < 500 m; Medium – 500-1000 m; High – > 1000 M) based on the length of upstream habitat available.

Culvert Type	Count	Low	Medium	High
Passable/Meets Guidelines	9	0%	56%	44%
Partial Barrier	9	56%	11%	33%
Full Barrier	28	46%	14%	32%

*Some categories may not add up to 100%; some culverts were not previously identified using GIS, and no watercourse was located at these points on the map, therefore upstream habitat gain could not be measured and therefore, prioritization could not be calculated.

Prioritization scores were calculated for all barrier culverts identified (see Appendix H), and were ranked from highest to lowest priority (Table 10).

Table 10. Culvert prioritization scores.

Priority	Culvert ID	Total Score
1	BLK004	35
2	NIC030	22
3	BLK006	20
3	MED001	20
3	KEM002	20
4	BLK037	18
4	SPI003	18
4	NIC003	18
4	NIC024	18
5	BLK047	17
6	MED003	15
7	MED004	14
7	BLK013	14
7	BLK051	14
7	BLK041	14
7	NIC011	14
7	KEL012	14
8	BLK019	12
8	BLK022	12
8	BLK016	12
8	BLK049	12
8	NIC002	12
8	NIC010	12
8	NIC014	12
8	NIC017	12
8	BEZ004	12
8	OAK009	12
8	OAK006	12
8	BEL005	12
9	BLK038	7
9	NIC028	7
9	NIC012	7
9	BEZ005	7
9	NIC018	7

4.0 Restorations

Between August 2012 and September 2012, CARP completed 11 remedial actions within the 2 sub-watersheds that were focused on; 5 in the Black River sub-watershed, 6 in the Nictaux River sub-watershed (Figure 4). An additional remediation occurred at a site located on Troop Brook in Granville Ferry. More than 15 km of upstream habitat was restored and made available to migrating fish species. The remediations included 11 debris removals and the retrofitting of a rock weir that was constructed during the 2011 field season (Figure 5). Refer to Table 6 for the road-watercourse crossings selected for remediation.

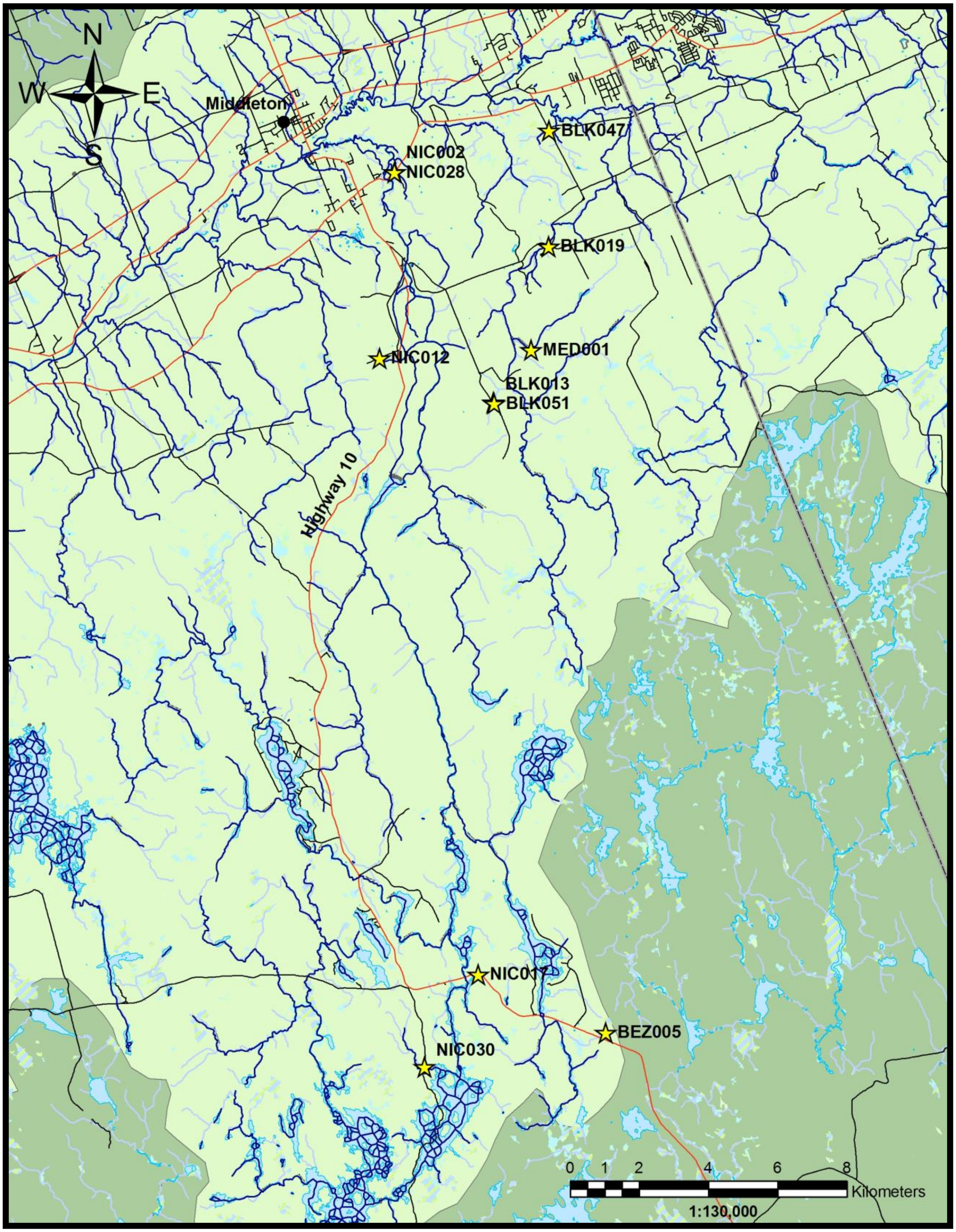

Figure 4. Road-watercourse crossings selected for remediation in 2012.

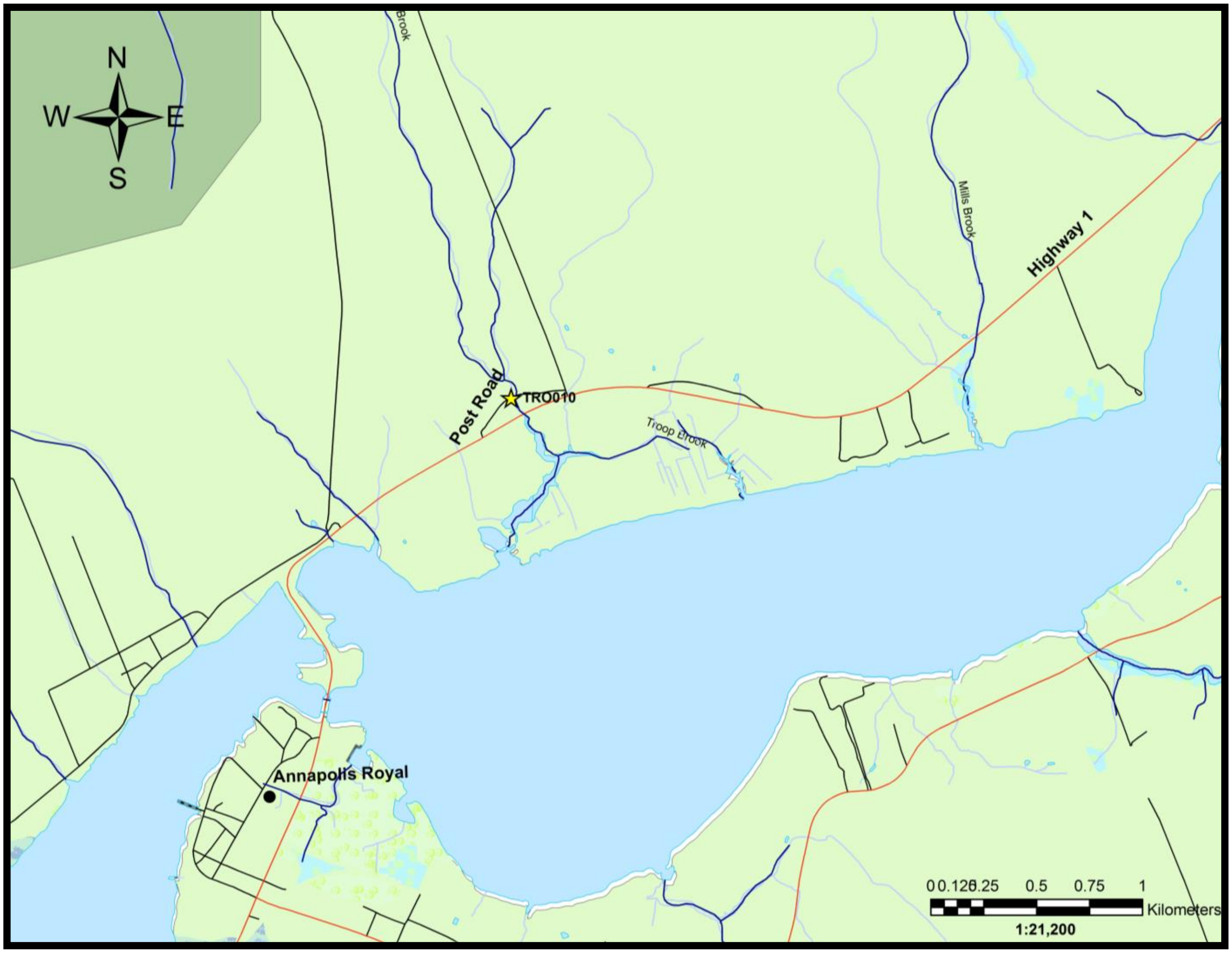

Figure 5. Location of TRO010 where a previous installed rock weir was retrofitted in 2012.

Table 11. List of road-watercourse crossings selected for remediation in 2012.

Site ID	Watercourse Name	Road Name	UTM Easting	UTM Northing	Restoration Type
BLK019	Unnamed tributary to the Black River	Whitman Branch	343858	4875276	Debris Removal
BLK047	Unnamed tributary to the Black River	Torbrook Road	343873	4978631	Debris Removal
BLK013	Unnamed tributary to the Black River	Bloomington Road	342263	4970757	Debris Removal
BLK051	Unnamed tributary to the Black River	Bloomington Road	342281	4970723	Debris Removal
MED001	Meadow Brook	Off Allen Lake Road	343352	4972275	Debris Removal
NIC002	Unnamed tributary to the Nictaux River	HWY 201	339410	4977432	Debris Removal
NIC028	Unnamed tributary to the Nictaux River	HWY 201	339403	4977420	Debris Removal
NIC012	Unnamed tributary to the Nictaux River	Neily Road	338968	4972040	Debris Removal
NIC030	Unnamed tributary to the Nictaux River	Old Liverpool Road	340273	4951524	Debris Removal
NIC017	Unnamed tributary to the Nictaux River	HWY 10	341824	4954199	Debris Removal
BEZ005	Bezant Lake Brook	Off HWY 10	345507	4952516	Debris Removal
TRO010	Troop Brook	Post Road	302036	4959737	Rock Weir

4.1 Debris Removals

Over time, leaf litter, fallen branches, rocks and garbage are deposited into the stream either directly from the stream banks, or indirectly via high flow events. This debris can be carried downstream through the watercourse and it may accumulate at the inflow or outflow, or even inside of the culvert. Once a debris build up begins, more debris will continue to build up around it, and eventually it will create a barrier to fish attempting to migrate through the culvert. Grates and cages are often placed at the inflow mouth of the culvert as a way to reduce debris jams within the culvert. These however, tend to cause greater problems, as the openings are too small to allow debris to pass through them, resulting in a debris blockage, if they are not cleaned on a regular basis. Beaver dams are also another source of debris blockage. Beavers tend to build their dams either inside, at the mouths, or directly upstream or downstream of a culvert. Dams impede fish movement through the culverts, as well as impact water levels by partially or fully restricting water flow through the culverts.

Debris removals involved removing branches, dams, rocks, leaf litter and garbage by hand with the use of handsaws and shovels.

BLK013/BLK051 - Black River

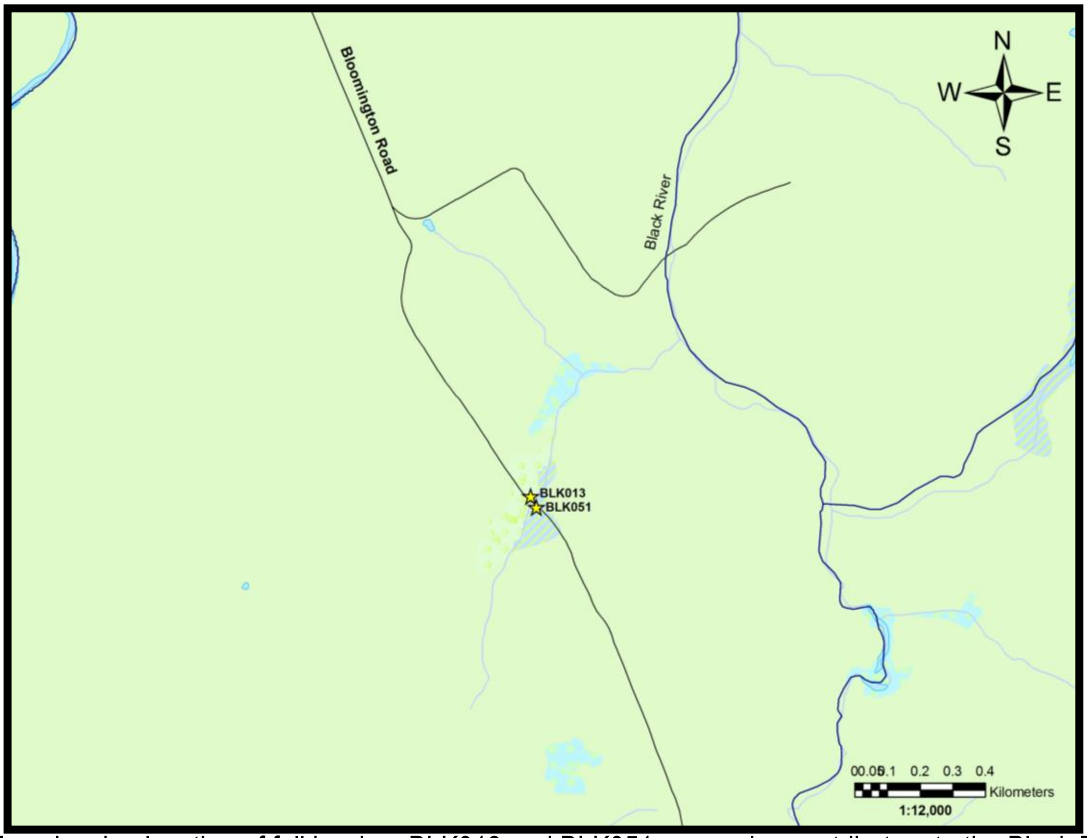

Figure 6. Map showing location of full barriers BLK013 and BLK051 on a unknown tributary to the Black River.

BLK013 and BLK051 are both spiral corrugated metal culverts on an unknown tributary to the Black River, located on Bloomington Road, near Bloomington, south of Middleton (Figure 6). BLK013 had previously been identified using GIS, and BLK051, which is located approximately 37 m away, had not been previously identified. The remediation of these two culverts restored access to approximately 0.72 km of upstream habitat, as well as restored access to 29, 404.79 m^2 of lake and wetland habitat.

BLK013 had a debris grate at the inflow mouth of the culvert that had collected a large amount of vegetation (Figure 6). Additionally, a beaver dam was present in the outflow mouth of the culvert that was restricting the majority of the water flowing through the culvert (Figure 7). Once the beaver dam had been removed and the inflow grate was cleared, the water velocity increased (Figure 9). However, when CARP staff visited the site 1 week post-debris removal, vegetation and debris had already began to clog up the inflow grate (Figure 10). It is recommended that the owner of the culvert either remove the inflow grate, or ensure that it receives regular maintenance to remove debris build-ups.

BLK051 also had a debris grate at the culvert inflow, which had a large accumulation of vegetation and sediment build up, restricting water flow through the culvert (Figure 11).

Figure 7. Vegetation build up at the inflow grate at

Figure 8. Beaver dam at the outflow of BLK013.

Figure 9. Water flowing through BLK013 after clearing away the beaver dam and unclogging the inflow grate.

Figure 10. Vegetation build up at inflow grate at BLK031, 1 week post debris removal.

Figure 11. Vegetation and sediment build up at the inflow grate at BLK051.

BLK019 – Black River

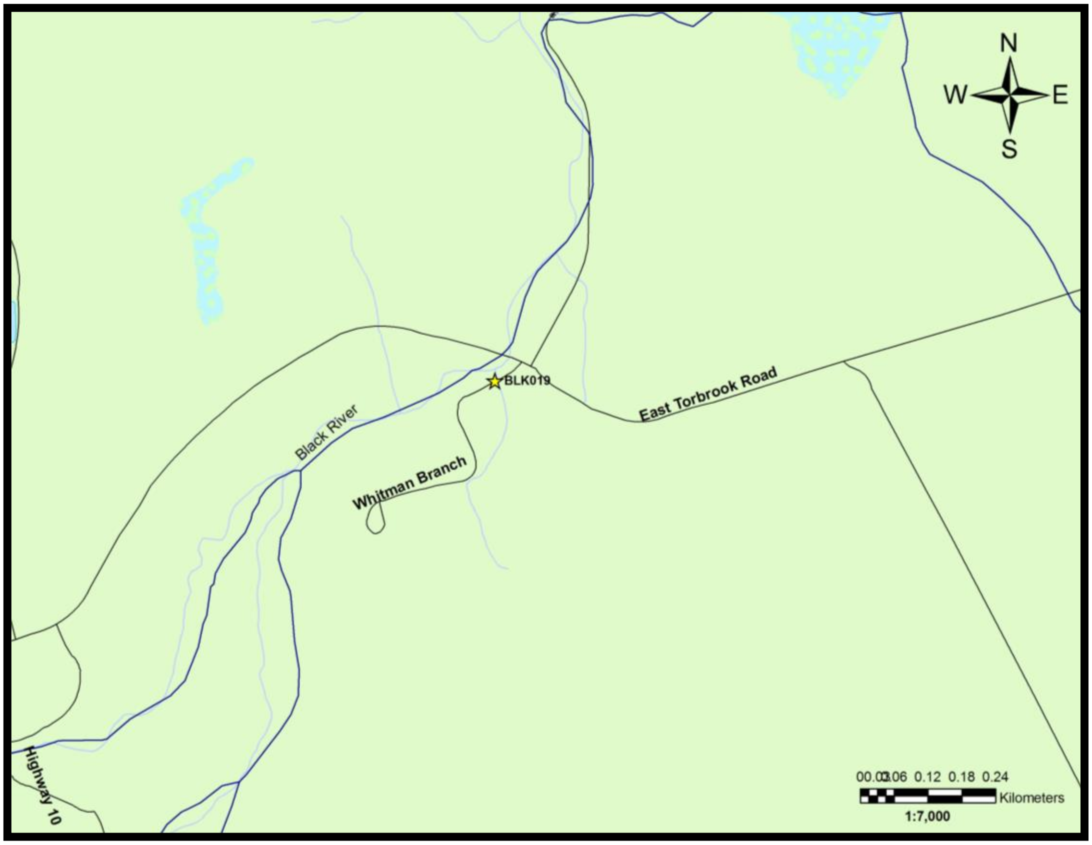

Figure 12. Map showing location of full barrier BLK019 on an unknown tributary to the Black River.

BLK019 is a wooden box culvert located on an unknown tributary to the Black River, on Whitman Branch, near Torbrook (Figure 12). This barrier restricts 0.39 km of upstream habitat.

The upstream consists of a boulder step-pool habitat. It appeared to be a dumping ground for garbage, as there was a large quantity of old rusty paint cans, pieces of metal and old tires. There were also fallen branches in and around the stream (Figure 13). Just upstream of the culvert the stream had a built up bar of mud and sediment overtop of the rocks (Figure 14). All of the garbage was collected and disposed of, fallen branches were moved over a rock wall that was lining the stream, and portion of the sediment bar was dug through to allow for water to flow through a channel to the mouth of the culvert.

Figure 13. BLK019 upstream habitat before (A) and after (B) the removal of branches.

Figure 14. BLK019 upstream sediment build up before (A) and two weeks post-debris removal (B).

BLK047 – Black River

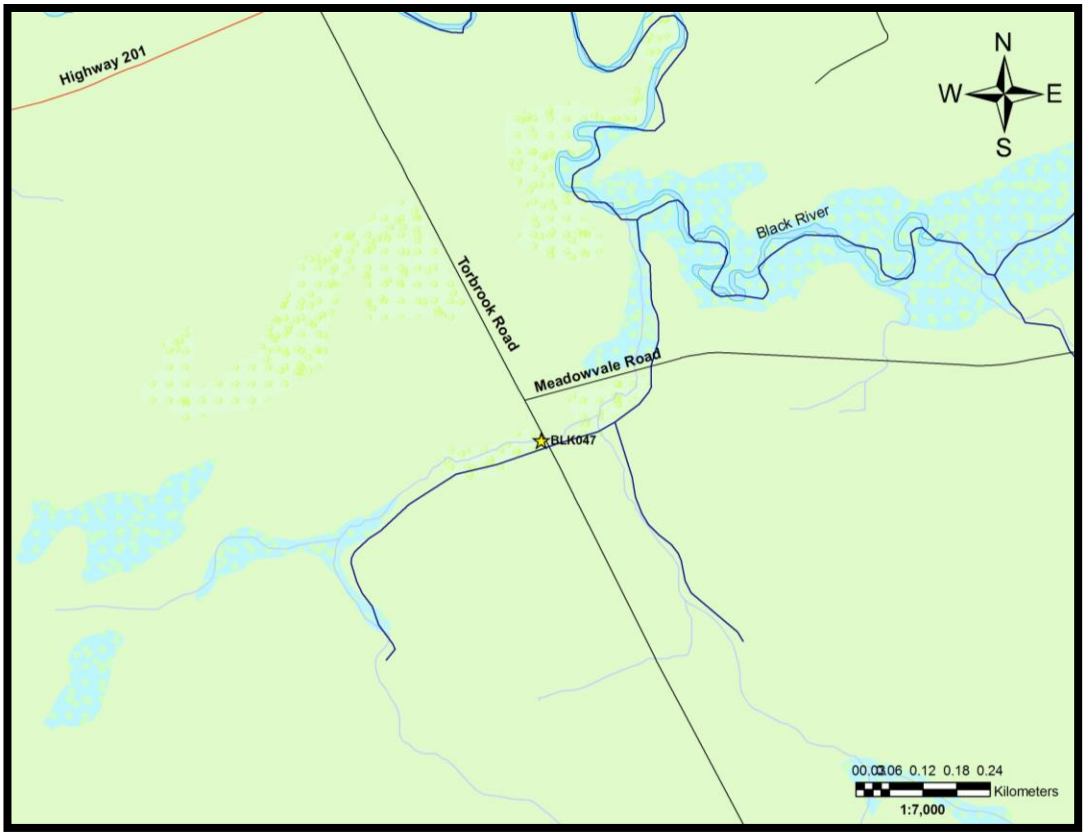

Figure 15. Map showing location of full barrier BLK047 on an unknown tributary to the Black River.

BLK047 is a system of two circular corrugated metal culverts, located on Torbrook Road, near Meadowvale (Figure 15). This system of culverts restricts 2.98 km of upstream habitat, as well as access to some wetland habitat.

There was a stump of a dead tree between the two culverts, minimizing the amount of water flowing through one of the culverts, and there was also a lot of vegetation growing around the stump (Figure 16). Once the stump was removed, water began flowing through both culverts. Directly downstream of the culverts there were many fallen branches in and across the stream (Figure 17). A handsaw was used to aid in the removal of fallen branches.

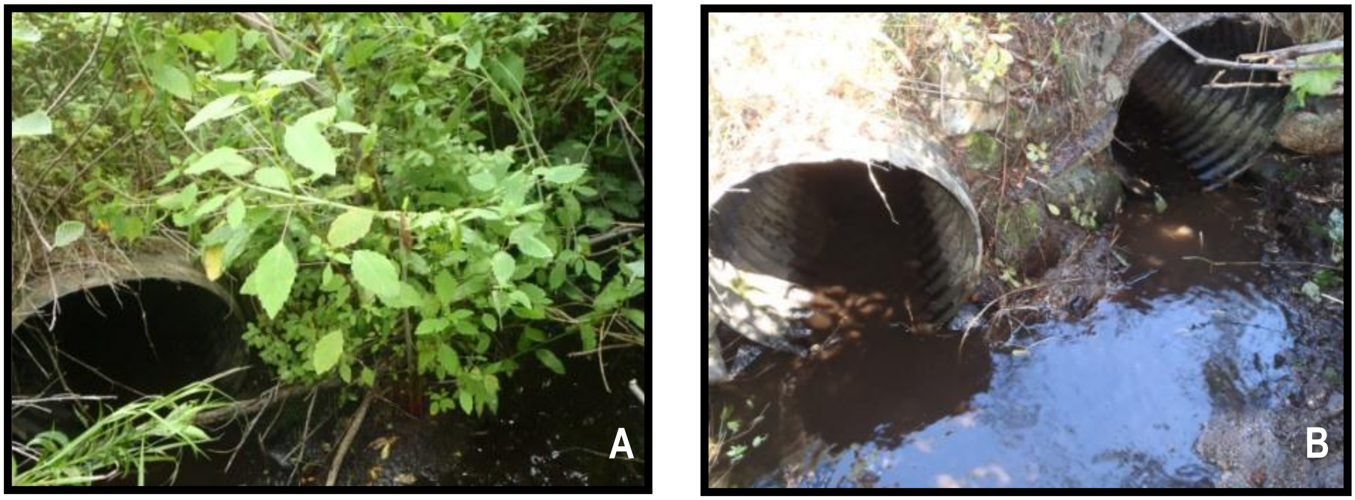

Figure 16. BLK047 inflow before (A) and after (B) the removal of the tree stump.

Figure 17. BLK047 downstream before (A) and after (B) debris removal.

MED001 – Meadow Brook

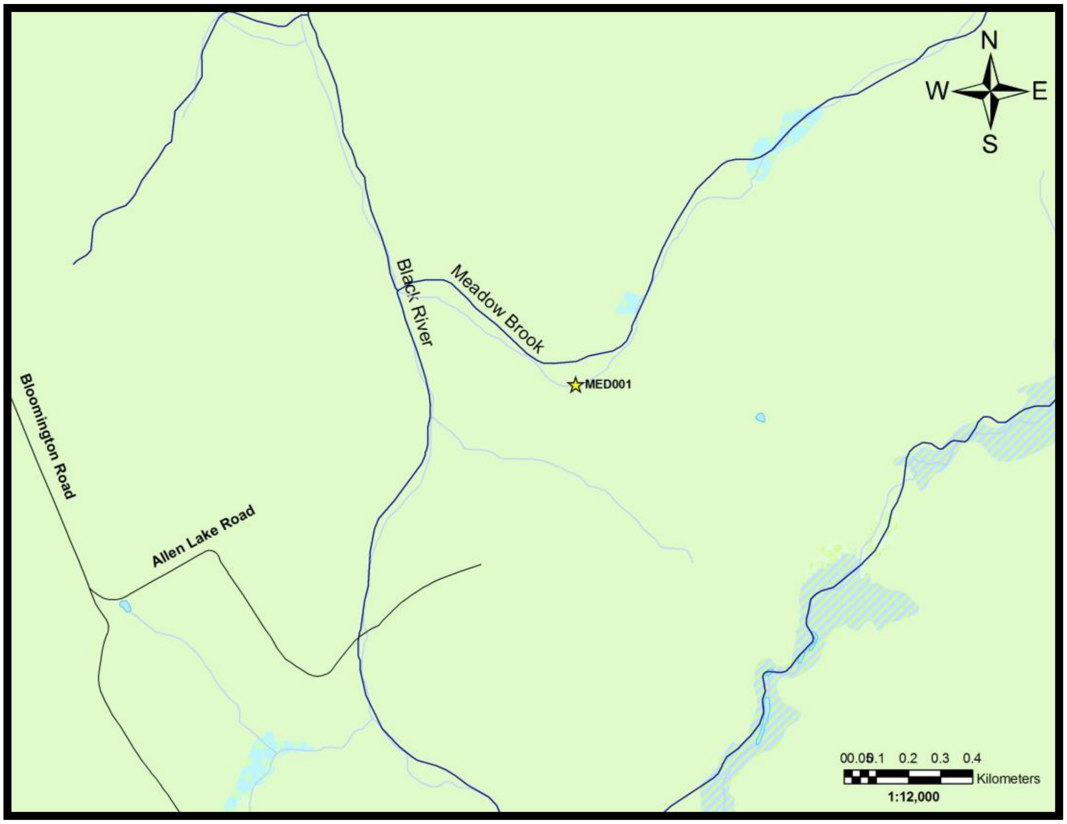

Figure 18. Map showing full barrier MED001 on Meadow Brook, a tributary to the Black River.

MED001 is a circular corrugated metal culvert located on Meadow Brook, which is a tributary that drains into Black River just downstream of Allen Lake Road near Bloomington (Figure 18). The culvert is severely deteriorated, and has a partially rusted out bottom at the inflow. At one point in time MED001 may have been a system of two culverts, but presently, the second culvert is only evident on the outflow side (Figure 19). CARP staff searched for the inflow, but there was evidence that it had at least partially been removed (Figure 20). MED001 restricts 2.20 km of upstream habitat that opens up into a lake.

A large amount of sediment had built up around some branches that were blocking the inflow of the culvert, completely blocking water flow through the culvert (Figure 21). Slightly upstream of the culvert there were a lot of old fallen branches littering the banks and the stream. Both the inflow blockage and the fallen branches were removed (Figure 22).

Figure 19. Two culverts at the outflow side of MED001.

Figure 20. Evidence of a partial culvert removal at MED001.

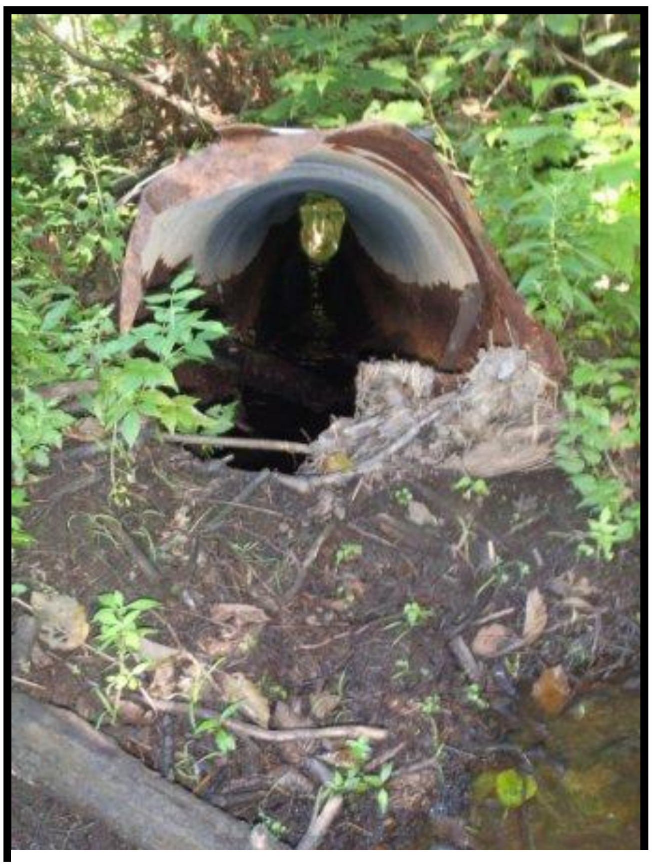

Figure 21. Debris blockage at inflow of MED001.

Figure 22. MED001 inflow after debris removal.

NIC002/NIC028 – Nictaux River

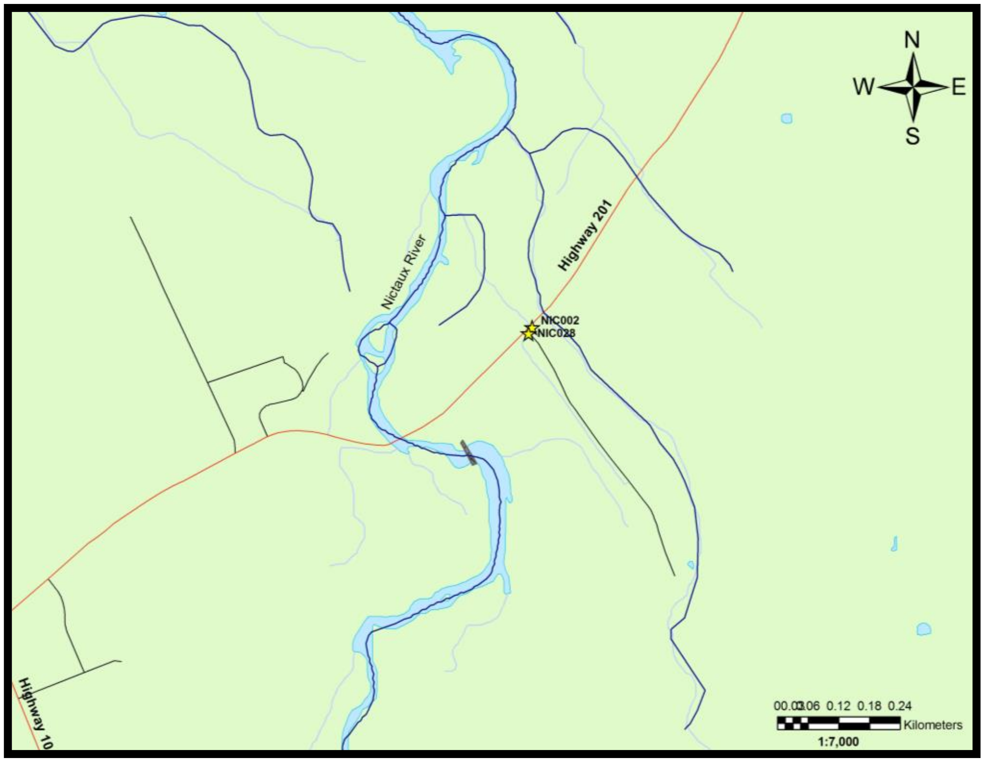

Figure 23. Map showing the location of full barriers NIC002 and NIC028 on an unnamed- tributary to the Nictaux River.

NIC002 and NIC028 are a system of two culverts on an unnamed tributary to the Nictaux River (Figure 23). NIC002 is a circular corrugated metal culvert that runs underneath Highway 201 and NIC028 is a circular corrugated plastic culvert that is directly upstream of NIC002, approximately 4 m from Highway 201 down an unnamed road that leads to a quarry. Combined, these two culverts restrict approximately 0.393 km of upstream habitat.

NIC002 had some large boulders around the inflow mouth that had caused an accumulation of branches and sediment causing an inflow drop into the culvert (Figure 24). CARP staff removed the debris build up and moved one of the boulders so an accumulation of debris would not occur in the future (Figure 25). NIC002 is fed both by NIC028 as well as another stream that runs parallel to the road down to the quarry.

NIC028 has a grate at the inflow of the culvert. A large quantity of dead vegetation and garbage had accumulated on the grate (Figure 26). The grate was slightly angled away from the culvert at the top, allowing some water to still flow through the culvert between it and the grate. Because of the lack of water flowing through this culvert, a sediment bar had formed downstream of the culvert, between NIC028 and NIC002. Once the inflow grate was cleared, and more water was flowing through NIC028, the sediment bar began washing away.

It is recommended that the owner of NIC028 regularly clears or completely removes the inflow grate. CARP staff noted that with more water flowing through NIC028, there is an increase in water velocity at the outflow of NIC002. If the grate issues at NIC028 are resolved, then NIC002 may have to be reevaluated for velocity issues in the future.

Figure 24. Inflow drop at NIC002.

Figure 25. NIC002 inflow after debris removal.

Figure 26. Debris blockage at NIC028.

Figure 28. High water velocity downstream of NIC002 after debris removal at NIC028.

Figure 27. NIC028 inflow grate after debris removal.

NIC012 – Nictaux River

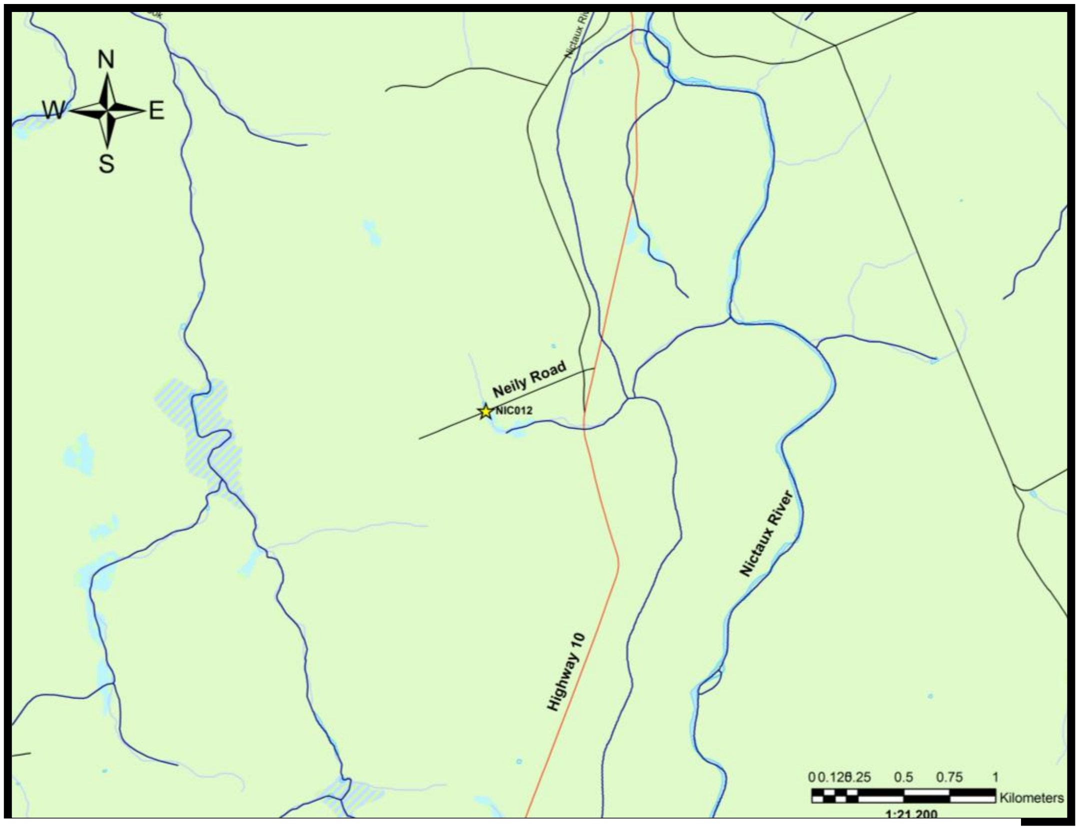

Figure 29. Map showing the location of partial barrier NIC012, an unknown tributary to the Nictaux River.

NIC012 is a wooden box culvert, located on Neily Road near Nictaux South (Figure 29). An abandoned beaver dam had been built just downstream of the culvert, restricting any upstream migration of fish through the culvert (Figure 30). When CARP staff went back to the site to remove the beaver dam (Figure 31), a bale of hay had been placed at the inflow mouth of the culvert (Figure 32). The removal of the beaver dam restored access to 0.334 km of upstream habitat, including access to wetland area.

Figure 30. Beaver dam downstream of NIC012

Figure 31. NIC012 downstream after debris removal.

Figure 32. Bale of hay at the inflow of NIC012.

NIC030 – Nictaux River

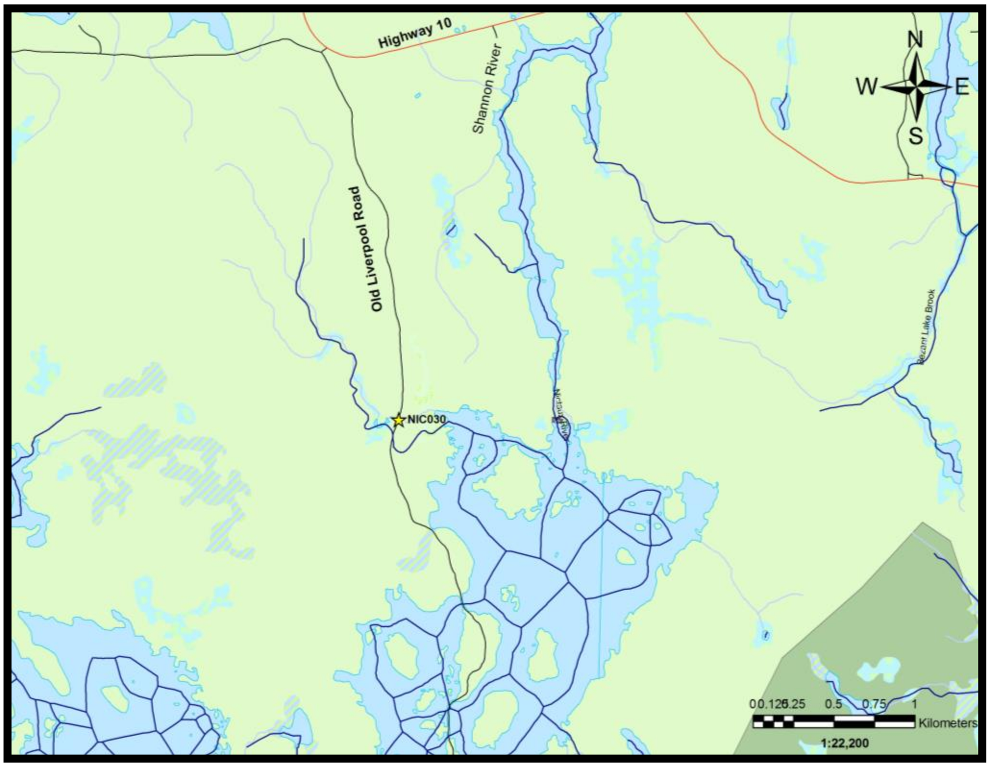

Figure 33. Map showing the location of full barrier NIC030 on an unnamed tributary to the Nictaux River.

NIC030 is a system of 3 circular corrugated metal culverts that run underneath Old Liverpool Road near Albany Cross (Figure 33). Two of the culverts are directly beside each other, with one large grate covering the inflow of both culverts, and the third culvert is approximately 4 m away (Figure 34). This system of culverts lies upstream of McGill Lake, and it restricts 2.98 km of upstream habitat as well as access to small bodies of water and wetland areas.

The inflow grate over the two culverts was covered with dead vegetation (Figure 35) and there was a beaver dam just inside of the inflow mouth of the third culvert. The grate was cleared and the beaver dam was removed (Figure 36).

One month after the debris removal, a member of the public informed CARP that the water level on the upstream side of the culvert had risen almost to the road, indicating that there was another debris blockage. When CARP staff visited in November, there was a new beaver dam at the outflow of the third culvert, and the shoulder of the road overtop of the third culvert had begun to sink in (Figure 37).

It is recommended that the inflow grate be completely removed, or receive regular (yearly) maintenance.

Figure 34. Three culvert system at NIC030.

Figure 35. Removing debris blockage at inflow grate at NIC030.

Figure 37. Third culvert at NIC030 after beaver dam removal.

Figure 36. Shoulder of road sinking in beside third culvert at NIC030.

NIC017 – Nictaux River

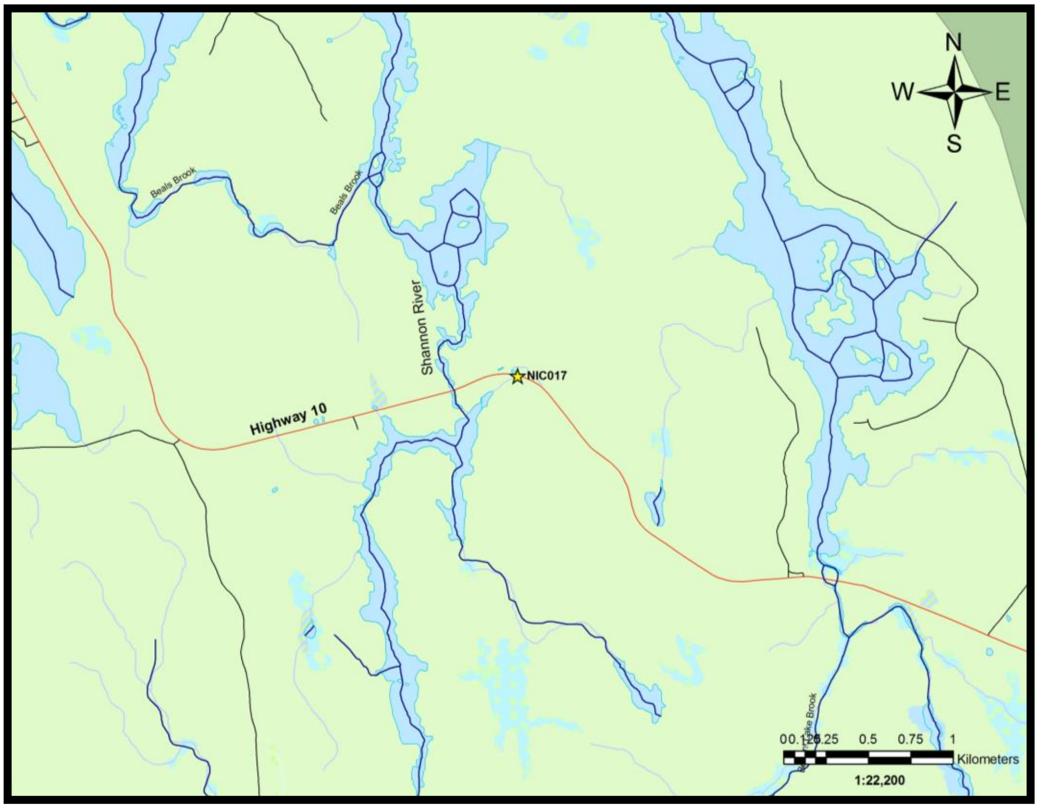

Figure 38. Map showing the location of full barrier NIC017 on an unknown tributary to the Nictaux River.

NIC017 is a cement box culvert that runs underneath Highway 10 near Albany Cross (Figure 38). There was a beaver dam at both the inflow and outflow mouths of the culvert and there was very minimal water movement through the culvert. Both beaver dams were removed by hand, restoring water flow through the culvert (Figure 39, Figure 40). The debris blockages at this culvert restrict approximately 0.123 km of upstream habitat.

Figure 39. NIC017 outflow (A) and inflow (B) before the removal of the beaver dam.

Figure 40. NIC017 outflow (A) and inflow (B) after the removal of the beaver dam.

BEZ005 – Bezant Lake Brook

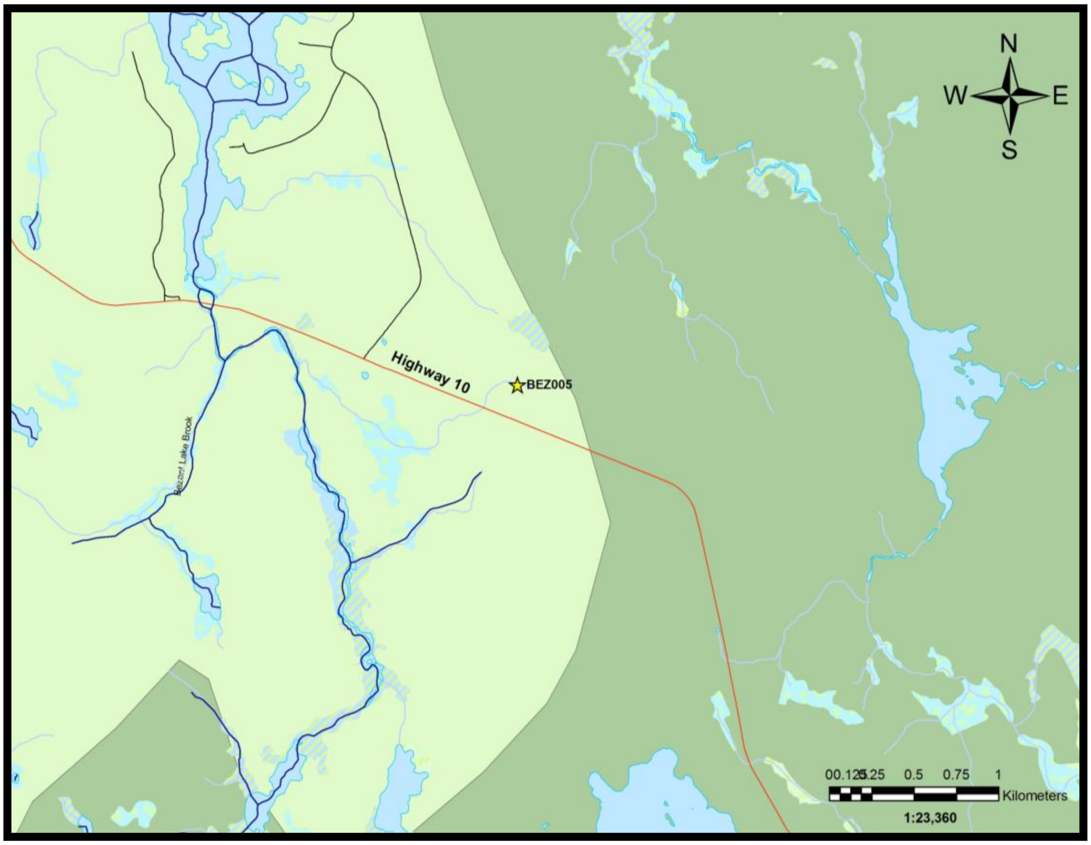

Figure 41. Map showing the location of full barrier BEZ005 on Bezant Lake Brook, a tributary to the Nictaux River.

BEZ005 is a circular corrugated plastic culvert off of Highway 10 on Bezant Lake Brook, a tributary to the Nictauc River, near Albany Cross (Figure 41). There is a grate at both the inflow and outflow of the culvert, as well as a large quantity of branches along the banks of the stream (Figure 42). There is 0.074 km of upstream habitat and access to a large wetland area restored by the removal of this debris blockage.

Figure 42. BEZ005 downstream before (A) and after (B) debris removal.

4.2 <u>In-stream Structures</u>

In stream structures such as tailwater controls or rock weirs are designed to aid in the restoration of fish passage through a culvert by elevating the water level within and around the culvert. The structures are typically placed at the tailwater control, which is the transition area between the tail of the outflow pool and the rest of the watercourse. A major issue with culverts that impede fish passage is a large outflow drop, also referred to as a hung culvert. When an outflow drop is too high, fish will not be able to jump up into the culvert and pass through successfully. The proper installation of a rock weir will elevate the water level of the outflow pool, creating more adequate water levels to allow for fish passage.

A rock weir is an effective and affordable option for a non-governmental organization such as CARP. The installation of a rock weir, however, is not the solution to all outflow issues; rock weir construction is only recommended if the culvert has an outflow drop that is less than 30 cm. If the outflow drop is greater than 30 cm, it is likely that the structure itself will become a barrier to fish passage in order for it to function properly.

Rock Weir Design (Taylor 2010)

Refer to Broken Brooks 2010: Repairing Past Wrongs (Taylor 2010) for more details on the design and installation process.

TRO010 – Troop Brook

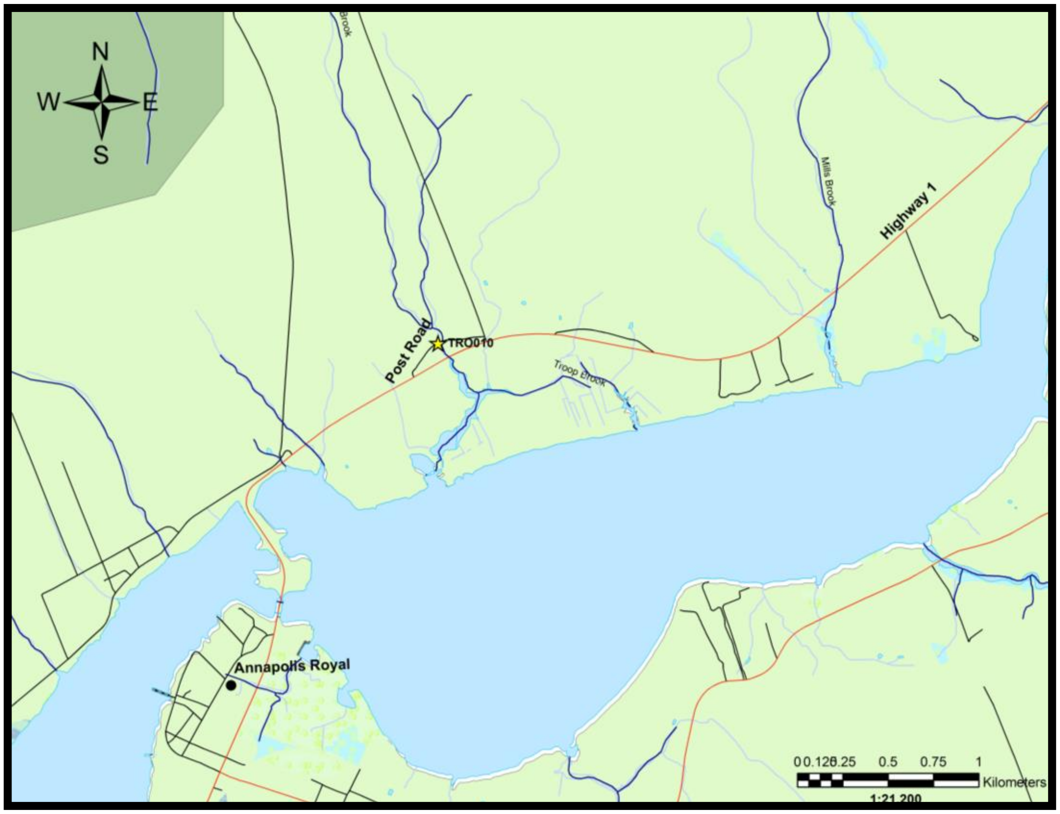

Figure 43. Map showing the location of TRO010.

TRO010 is a system of two circular corrugated metal culverts, located on Troop Brook, in Granville Ferry (Figure 43). Since 2010, two tailwater control rock weirs have been installed at this location as a means to reduce the outflow drop at the culverts. The first rock weir (Weir A) was installed in 2010, and was successful in raising the water level of the outflow pool to the outflow of the culvert, which eliminated the outflow drop. Unfortunately, the culvert slopes are quite substantial, at 1.6% and 1.9%, which classified both culverts as partial barriers. In an attempt to accommodate the slope issue, a second weir (Weir B) was installed in 2011, 8.36 m downstream of Weir A. This configuration created a step-up pool system, and it allowed for the height of Weir A to be raised slightly. During the installation of Weir B in 2011, Weir A also received some maintenance to replace dislodged rock.

WEIR A

The rock weir installed in 2010 functioned well; however, some of the rocks used had been dislodged over time. It also needed to be raised slightly, to further backwater the culverts. CARP staff added rock to Weir A to help stabilize the structure and to ensure its continued function. During maintenance, the low flow notch was built slightly higher in hope of backwatering the culvert to at least half its length. Refer to *Broken Brooks: Repairing Past Wrongs* (Taylor 2010) for the initial design and *Broken Brooks 2011: Assessing and Restoring Aquatic Connectivity in the Annapolis River Watershed* (Postma 2011) for the modifications made to the structure.

WEIR B

The rock weir installed in 2011 was installed 8.36 m downstream of Weir A, at a section of the stream that had a natural accumulation of rock. The purpose of installing a second weir was to back the water up to Weir A, so that the low flow notch could be built up higher, which would allow for the culverts to be further backwatered. The elevation difference between the low flow notches of Weir A and Weir B is 0.52m. Refer to *Broken Brooks 2011: Assessing and Restoring Aquatic Connectivity in the Annapolis River Watershed* (Postma 2011) for the initial design of the rock weir.

When CARP staff visited TRO010 in September 2012, both Weir A and Weir B appeared to be functioning properly. However, it was noted that although Weir B was backing up the water to Weir A, its slope appeared to be too steep, and would potentially be a barrier to fish passage (Figure 44). To remediate this, Weir B underwent some maintenance, the decrease the grade of the weir (Figure 45).

Approximately 1.5 tons of weir rocks were obtained from the local quarry, and distributed into the stream around Weir B by hand. Since the incipient rock diameter was calculated for Troop Brook in 2010, the same calculated value, 18 cm, was used (Taylor 2010).

Figure 44. Weir B at TRO010 before undergoing maintenance.

Figure 45. Weir B at TRO101 after maintenance to decrease the slope.

5.0 Recommendations

1. Based on the modification made to the culvert assessment protocol in 2012, where all culverts on potential fish habitat stream receive detailed assessments, CARP staff must revisit culverts that were deemed fully passable in previous field seasons because they were backwatered and/or had a natural bottom.

2. In previous years, some culverts were identified as barriers through a preliminary assessment, but did not receive detailed assessments. These culverts should be identified, and full assessments should be completed.

3. A rapid fish habitat assessment protocol should be developed and added to the culvert assessment protocol. This could be a useful tool in prioritizing barriers for remediation, to ensure those with the best fish habitat are targeted first.

4. Culvert assessments should continue to be focused primarily within prioritized sub-watersheds. This allows for a better understanding of the overall connectivity within a specific system and a focused approach targeting areas of suitable fish habitat.

5. If entire sub-watersheds are selected, full fish habitat suitability assessments, water quality assessments and fish population surveys should be completed alongside culvert assessments. Knowing the general health of the sub-watershed can help focus additional restoration and conservation efforts.

6. TRO010 should be revisited in spring or early summer to ensure Weir B is functioning properly, and is conducive to fish passage.

7. A *Broken Brooks* database should be created in Microsoft Access to simplify data entry. Data from every field season would then be available in one location.

8. An Excel-based tool should be developed to apply barrier classification for various-sized fish based on inputted values for outflow drop. With this, barrier culverts for spawning adults, as well as other life stages and species can be identified. Without the presence and successful spawning of adults, there would be no young of the year and juveniles in the system. Being able to identify barriers that limit access to suitable spawning grounds could have a positive effect on the reproductive success of the population (MacMillan, J., pers. comm., November 26, 2012).

6.0 Atlantic Salmon Habitat Restoration Management Plan

Atlantic salmon (*Salmon salar*) is an anadromous fish species, native to Nova Scotia. Adults migrate upstream into freshwater rivers and streams to spawn. Once the eggs hatch, the young salmon remain in gravelly freshwater habitats for 2 or 3 years, before migrating downstream towards the ocean as smolts. They remain in the ocean until they reach sexual maturity, at which time they migrate back to their natal stream to reproduce (Scott and Crossman 1998).

Historically, Atlantic salmon were found in great abundance in several tributaries to the Annapolis River (Dalziel and MacEachern 1957). Both the Annapolis and Nictaux Rivers had reputations of being some of the best salmon rivers in Nova Scotia (The Outlook 1916). They had significant social and economic values within the local community. Citizens at that time recognized that these rivers needed to be protected in order to maintain the populations of Atlantic salmon (The Outlook 1910); however, over time the populations that once thrived in these areas were no longer present.

Using a literature review of several reports compiled by CARP in the early 1990's, including a pH study of streams within the Annapolis River watershed (Dickinson 1992) and an Annapolis watershed fish habitat restoration project (Parker 1993; Parker et al. 1994), a shortlist of 7 priority sub-watersheds within the Annapolis River watershed was created to focus Atlantic salmon habitat restoration work (Table 12). Six of the rivers run through the Torbrook Formation, which acts as a natural buffer against the acidification of water. The Round Hill River is the only river selected that does not run through the Torbrook Formation; however, it was selected in the 1990's for fish habitat restoration work because it exhibited good pH readings (average pH around 6.0), and it was also historically an Atlantic salmon River.

As an extension of *Broken Brooks*, the information collected from the culvert assessments, fish population surveys, and habitat suitability assessments were used to characterize the Black River sub-watershed and determine whether it has suitable habitat to support Atlantic salmon populations. Public meetings were held and a survey was distributed as a means of gathering more information on Atlantic salmon within the Annapolis River watershed, both historically and presently. This information will help to focus future restoration work.

Table 12. List of priority sub-watersheds for future Atlantic salmon habitat restoration work.

Sub-Watershed Name	Torbrook Formation	Historical pH Below Formation	Historical pH Above Formation
Bear River	Yes	6.0 – 6.5	5.0 – 6.1
Black River	Yes	6.0	5.6
Fales River	Yes	unknown	unknown
Moose River	Yes	6.0	4.6
Nictaux River	Yes	6.0	5.0
Round Hill River	No	n/a	n/a
South Annapolis River	Yes	5.6	4.61

6.1 Fish Population Surveys

Fish population surveys were conducted at 4 sites within the Black River sub-watershed and 2 sites within the Nictaux River sub-watershed during September 2012 (Table 13). Assessments consisted of a combination of electrofishing, minnow traps and beach seining (DFO scientific permit #324254). Initially, more sites had been identified for fish population assessments; however, due to time constraints and inclement weather, only 6 sites were assessed.

Table 13. Fish population survey locations within the Black River and Nictaux River sub-watersheds.

Site ID	Watercourse Name	Easting (m)	Northing (m)	Assessment Type	Date Assessed
NR01	Nictaux River	339709	4974721	Beach seine	05/09/2012
NR02	Nictaux River	339344	4977145	Beach seine	05/09/2012
BR01	Black River	343896	4975389	Electrofishing Minnow Trap	13/09/2012 14/09/2012
BR02	Black River	346259	4979016	Minnow Trap	18/09/2012
BR03	Black River	343407	4979538	Minnow Trap	21/09/2012
BR04	Black River	342695	4971487	Electrofishing Minnow Trap	26/09/2012 26/09/2012

6.1.1 Electrofishing

Electrofishing surveys were completed at 2 sites along the Black River (Table 13), using a Model 12 POW Electrofisher. Site selection was based on site characteristics such as stream width and depth; water velocity; and accessibility. Refer to Table 14, Table 15 and Table 16, Table 17 for the site-specific settings and catch records for sites BR01 and BR04, respectively.

Table 14. Settings used and site information for electrofishing site BR01, located off of East Torbrook Road, Torbrook.

Site ID	Pass	Total Time (s)	Pulse Width (ms)	Pulse Frequency (Hz)	Duty Cycle	Volts	Reach Length (m)	Average Depth (m)
BR01	1	677	5	30	G	600	19	0.53
	2	549	2	40	H	800		

No salmonid species were captured at this site. (Table 14)

Table 15. Species-specific catch records for the electrofishing survey conducted at BR01.

Pass	Species	Total Catch
1	American eel	1
1	lake chub	1
2	American eel	3
2	lake chub	1
2	northern brook lamprey	1
	Total	**7**

Table 16. Settling used and site information for electrofishing site BR04, located off of Allen Lake Road, Bloomington.

Site ID	Pass	Total Time (s)	Pulse Width (ms)	Pulse Frequency (Hz)	Duty Cycle	Volts	Reach Length (m)	Average Depth (m)
BR04	1	1111	6	30	G8	400	30.5	0.43
	2	1235	6	40	H8	500		

One brook trout was captured during the assessment; however, no Atlantic salmon were caught (Table 16). The water at both sites was very tannic, causing low visibility. It is possible that some fish were not captured.

Table 17. Species-specific catch records for the electrofishing survey conducted at BR04

Pass	Species	Total Catch
2	American eel	1
2	brook trout	1
2	white sucker	1
	Total	**3**

6.1.2 Minnow Traps

Minnow traps were set at 4 sites along the Black River (Table 13). The steel minnow trap was baited with dog kibble, weighted down with a rock, and once it was dropped in the water, it was secured to an object close to the stream bank. Soak time for the trap was typically between 18 and 26 hours (Table 18). One juvenile brook trout, as well as many native forage fish species were captured during the assessments. Refer to Tables 19 for site-specific catch records.

Table 18. Site-specific minnow trap soak times at 4 sites along the Black River.

Site ID	Date Set	Time Set (24-h; hh:mm)	Date Lifted	Time Lifted (24 h; hh:mm)	Total Soak Time (hh:mm)
BR01	13/09/2012	15:30	14/09/2012	09:15	17h 15m
BR02	17/08/2012	08:15	18/08/2012	10:10	26h 55m
BR03	20/09/2012	14:30	21/09/2012	15:30	26h 0m
BR04	25/09/2012	08:15	26/09/2012	10:05	25h 50m

Table 19. Site-specific catch records for minnow traps set at 4 sites along the Black River.

Site ID	Species	Total Catch
BR01	blacknose shiner	1
	Total	**1**
BR02	blacknose shiner	2
	ninespine stickleback	1
	threespine stickleback	8
	Total	**11**
BR03	blacknose shiner	3
	fourspine stickleback	1
	shiner spp.	1
	threespine stickleback	7
	white sucker	2
	Total	**14**
BR04	brook trout	1
	Total	**1**

6.1.3 Beach Seining

Beach seining was completed at 2 sites within the Nictaux River sub-watershed. In total, 5 native forage fish species were captured (Table 20).

Table 20. Site-specific catch records for beach seining at 2 sites within the Nictaux River sub-watershed.

Site ID	Seine Number	Species	Total Catch
NR01	1	Banded killifish	2
		Blacknose shiner	5
		Ninespine stickleback	2
		White sucker	4
		Total	**13**
	2	Banded killifish	1
		Blacknose shiner	65
		Ninespine stickleback	22
		Shiner spp.	2
		White sucker	6
		Total	**96**
NR02	1	Shiner spp.	1
		Total	**1**

6.2 Habitat Suitability Assessments

In July 2012, CARP participated in a 2-day pilot field testing of the Nova Scotia Fish Habitat Assessment Protocol (NSFHAP), held by Clean Nova Scotia and NSLC Adopt A Stream. Training included background theory and habitat suitability index information, followed by practical in-field work to ensure field staff were comfortable using the methodologies to complete the assessments.

The Nova Scotia Fish Habitat Assessment Protocol was created by Clean Nova Scotia in partnership with NSLC Adopt A Stream in 2012 as a way to standardize the field methodologies used in fish habitat assessments province-wide, utilizing key habitat variables specific to Nova Scotia. The field methodologies within this protocol are largely based on those derived from a Habitat Suitability Index (HSI) for brook trout within the United States. Habitat suitability assessments have been refined over many years as a method of evaluating the characteristics of a stream or river, using the habitat requirements and limiting factors for different species, to determine whether the studied systems are viable habitats for the selected species. The HSI for brook trout was established in 1982 by the Fish and Wildlife Service of the U.S. Department of the Interior (http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-024.pdf), which identified 17 habitat variables. Since the habitats in which brook trout are found in Nova Scotia are different from the habitats they prefer across North America, the NSFHAP uses only 13 of the habitat variables identified for brook trout, and has modified them to correspond more accurately with the habitat characteristics found within Nova Scotia.

6.2.1 Methodology

Habitat suitability assessments were completed at 3 sites within the Black River sub-watershed. A partial assessment was also completed within the Nictaux River sub-watershed (Table 21). Refer to *A Field Methods Manual for the Assessment of Freshwater Fish Habitat* (Brunner 2012) for a detailed description of the habitat variables and methodologies used for performing fish habitat suitability assessments.

Table 21. Habitat suitability assessment sites within the Black River and Nictaux River sub-watersheds.

Site	River Name	Watershed Code	Site Boundary (Easting (m)/Northing (m)) Downstream		Upstream		Site Length (m)	Date Assessed
1	Black River	01D02	342690	4971466	342727	4971243	244.2	11/10/2012
2	Black River	01D02	343928	4975466	343892	4975358	120	19/10/2012
3	Black River	01D02	347016	4978095	347052	4918105	38.64	24/10/2012
4	Nictaux River	01D02	340149	4969065	340134	4968957	363.6*	25/10/2012

*Only half of this assessment was completed, site length is calculated at the beginning for the entire reach – 181.8m was surveyed. Downstream UTMs used correspond with the last transect completed.

Fish habitat assessment procedure:

1. Upon arrival at the site, a water quality sample should be taken before transects are laid, to avoid disturbing the sediment and skewing readings.

2. Using a measuring tape, measure the bankfull width in meters. Bankfull width is the measurement used to define the spacing between each transect assessed (6 transects total), as well as the total length of the reach (6 times the bankfull width).
3. It is important to get a good representation of the natural stream course within the reach; transects should be located along the deepest part of a pool, across a riffle or across a run.

4. Record UTM coordinates at both the upstream and downstream boundaries of the reach, as well as at each transect.

5. Once a transect is established, the average right and left floodplain width, bankfull width and wetted with (all in meters) were measured.

6. Run a measuring tape run across the stream and stake it into the ground to set up a channel cross section (Figure 46).

7. Divide the wetted width of the stream into quarter sections and record depth measurements at each section.

8. Divide the wetted width of the stream into third sections and estimate the substrate composition and amount of instream cover for juvenile and adult fish (Figure 47).

9. When a transect runs through a pool, the average length and width, maximum pool depth, depth at the tail of the pool and the estimated low flow maximum depth are measured.

10. Riverbank and riparian characteristics, such as the percent of trees, shrubs, grass, bare soil, erosion and stable ground are assessed for both the right and left banks.

11. A benthic macroinvertebrate sample is taken at 1 transect along the reach, preferably at a transect along a riffle, using wither a 3 minute kick net sample, or a rock grab.

All of the data gathered was sent to Clean Nova Scotia for analysis, and the results are pending the completion of a central database and analysis tool.

Figure 46. Measuring tape run across a transect to set up a channel cross-section.

Figure 47. Field crew estimating substrate composition and instream cover along a transect.

6.3 Community Outreach

Engaging the local community was an important component for this project; however, it proved to be the most difficult aspect. The purpose of the outreach was two-fold: first, it was to help develop a prioritized list of sub-watersheds within the Annapolis River watershed; secondly, it was a way to gather information on Atlantic salmon within the watershed, both historically and today.

6.3.1 Atlantic Salmon Survey

An Atlantic salmon survey (Appendix I) was created as a tool to help gather some basic information on Atlantic salmon in the watershed. It gathered information on where salmon had been seen in the past, how stream conditions have changed, and what would be considered as the main cause of population declines. Surveys were distributed at all public meetings and presentations held, and it was also made available online using SurveyMonkey. A link to the survey was advertised on the CARP Facebook page, and sent out via email to various community groups. The results are summarized below.

6.3.1.1 Survey Results

The survey consisted of 10 questions. In total, 18 surveys were completed predominantly by individuals residing in Annapolis (38.8%) and Kings (33.3%) counties, but individuals from Halifax (5.5%), Lunenburg (5.5%) and Yarmouth (5.5%) counties also responded (Figure 48).

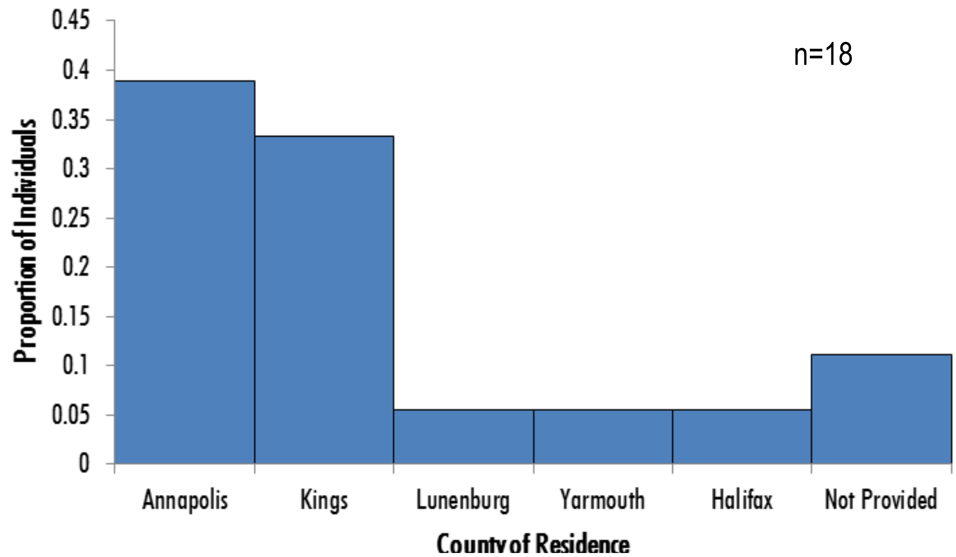

Figure 48. Proportion of individuals who answered surveys from different counties in Nova Scotia.

It was found that 83% of the people who completed the survey fished in streams within Annapolis and Kings counties (Figure 449). Specifically, 72.2% of the individuals fished in the Nictaux River, 44.4% fished in the Annapolis River and 27.7% fished in the Black River. Six additional rivers were also identified (Figure 50).

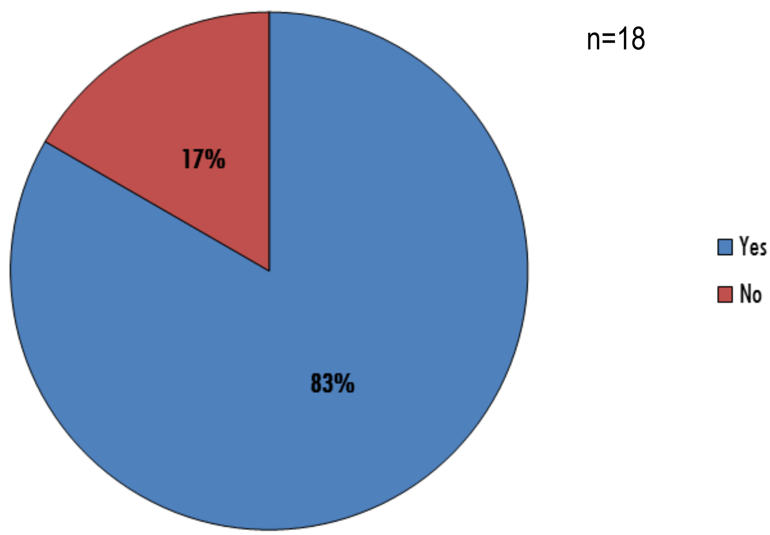

Figure 49. Percentage of people who fish within Annapolis and Kings counties.

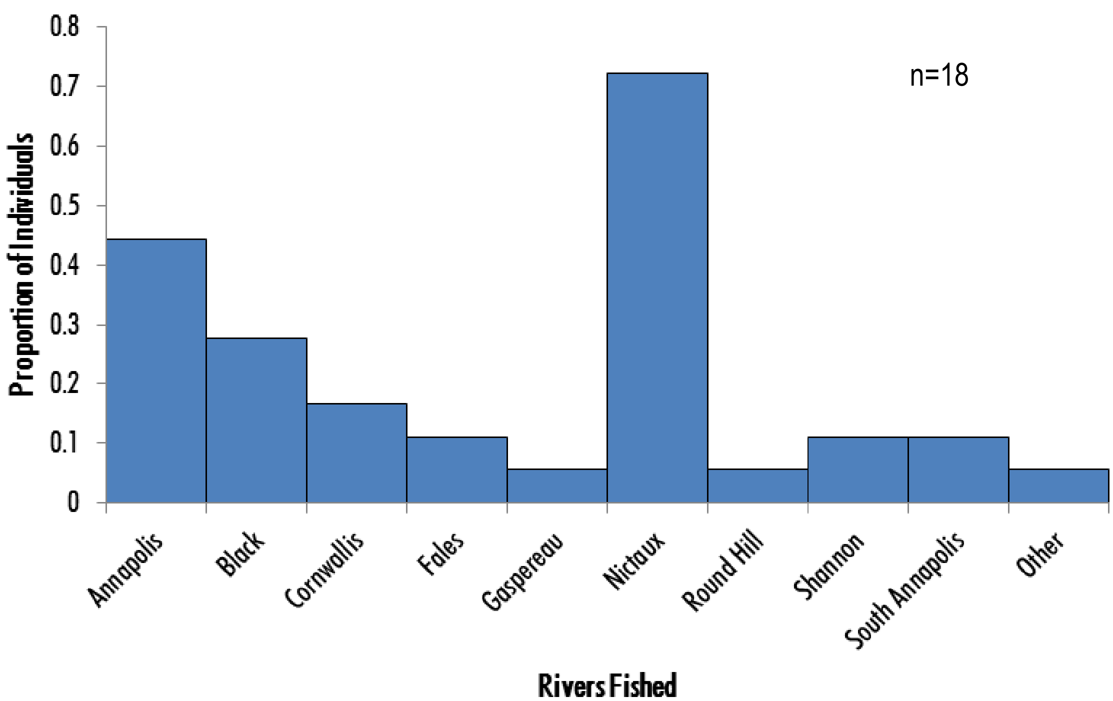

Figure 50. The proportion of individuals and the rivers within the Annapolis and Kings counties in which they fish.

Out of the 18 completed surveys, 56% of the respondents said that they had caught an Atlantic salmon as bycatch while out fishing, while 39% said they had not; one individual did not answer the question (Figure 49). Based on the individuals who had caught Atlantic salmon as bycatch, 73% of individuals had caught a salmon parr, 27% had caught a smolt and 45% had caught an adult (Figure 50).

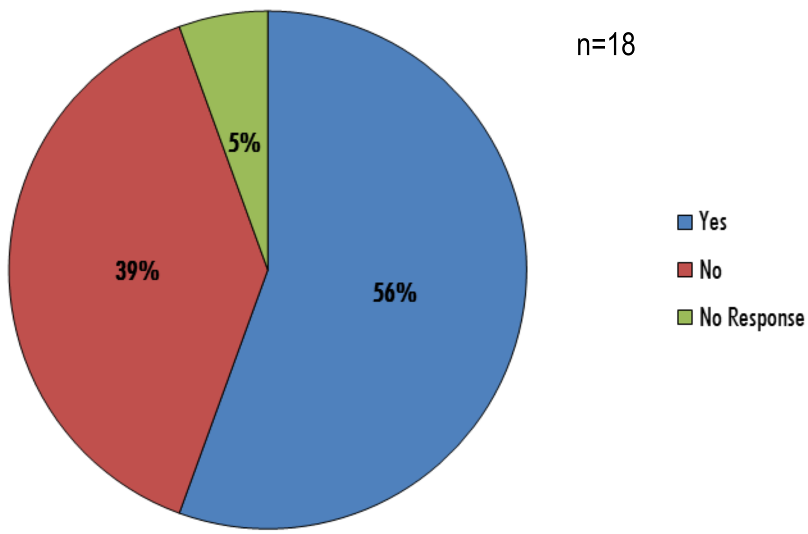

Figure 51. Percentage of individuals who have caught an Atlantic salmon as bycatch while fishing.

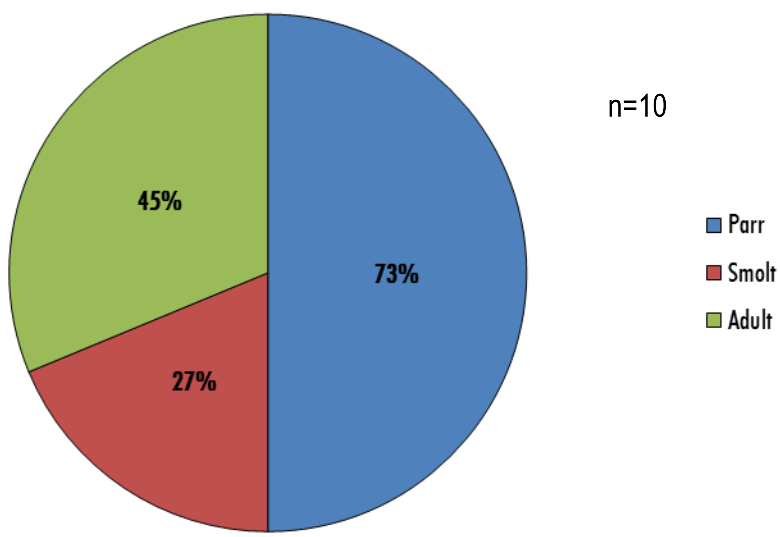

Figure 52. The percentage of individuals who had caught an Atlantic salmon as bycatch and which life stage they caught.

When asked which rivers Atlantic salmon had been observed in the past, 11 rivers were listed (Figure 53).

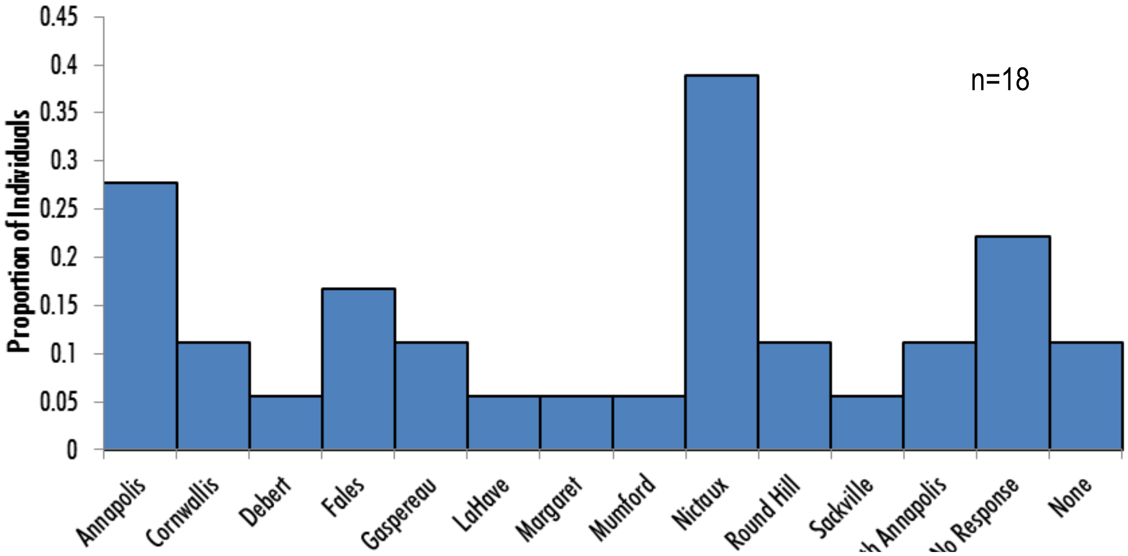

Figure 53. Proportion of individuals and the rivers where Atlantic salmon have been observed in the past.

A number of issues were highlighted when asked what primary issues the individual felt contributed to the decline of Atlantic salmon. Figure 54 shows the main issues brought up. Some of the most common answers include open-pen aquaculture, hydroelectric and tidal dams and acid rain. Among the issues categorized as other (suggested by one individual) included habitat destruction, sewage treatment runoff, pesticide runoff, mortality at sea, climate change and Nova Scotia Power.

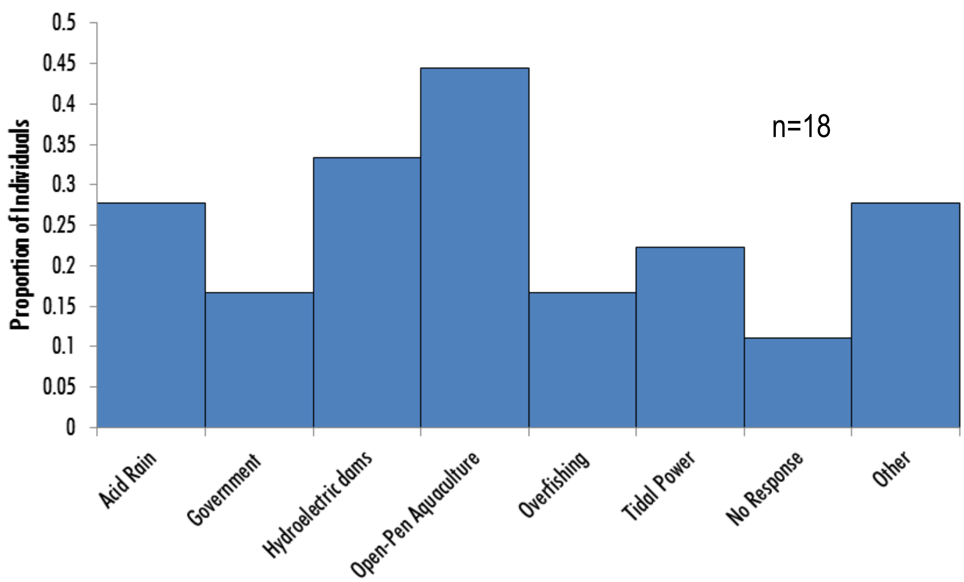

Figure 54. The primary issues contributing to Atlantic salmon declines and the associated proportion of individuals.

When asked if any changes to the rivers and streams had been noted, 50% of respondents answered yes, 39% answered no and 11% individuals did not respond (Figure 55). Comments provided identifying the observed changes include:

- Installation of hydroelectric dams
- No fishways
- Fluctuating water levels
- Introduction of invasive species (ex. Smallmouth bass)
- Overfishing
- Tidal power plant
- Fish farming in the Bay of Fundy
- Siltation after rainfalls
- Cleaner less pollution
- Less fish and more development close to the streams/rivers
- Habitat restoration efforts

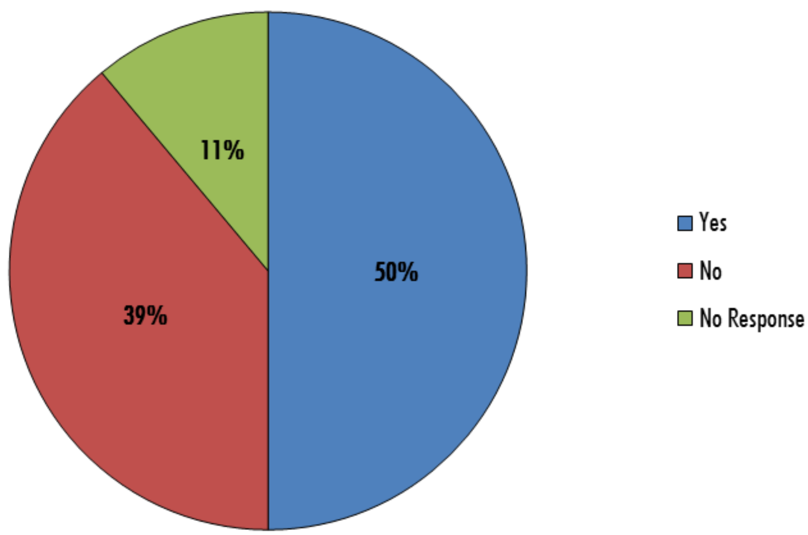

Figure 55. Percentage of individuals who have noticed changing conditions in rivers and streams.

Finally, the resp … s. Comments and concerns included:

- I would concentrate all efforts on shad in this system as we have 0 support from DFO regarding salmon and feedlots.
- I own the Martyn's Mill property. I would be very interested in hearing about any ideas to rejuvenate the Nictaux River to its former salmon glory.
- Great to see someone taking action to restore these salmon rivers you have my full support.
- A big project you have on hand. Determine what happened to the Bay of Fundy salmon first. Study the sea lice problem in detail. Will smolts survive in the bay? How far down? Can they get by the turbines? Lots more if you had the time.

- The big tidal power turbines may prove to be big fish grinders. The work that was done on studying the effects fish passage through the Annapolis Royal turbine showed negative impacts that have not been mitigated and I don't hear of any plans to correct this in the newer turbines. Liming programs have been proven to be effective but expensive and the government has not continued its efforts to combat acid rain with ongoing liming programs and has given up on the fishing resource. Fish catches everywhere are declining even with less fishing pressure as a lot of fishermen have given up fishing for some species in different areas due to lack of success. No one fishes salmon in southwest NS any more as they have all but disappeared and they are not doing anything that will bring them back to these once productive waters.
- Not only Atlantic salmon are affected by the above issues! Striped bass, speckled trout and American shad are also adversely affected!!!
- Trout populations increasing. More hatches=more forage.
- The Annapolis River needs to have all dams removed so it can be put back the way it was 50 years ago for the future generations to come…
- We must take care of what we have or lose it completely.
- The Annapolis watershed is one of a few in NS that maintains a relatively healthy pH despite acid precipitation. With proper management there is a high potential for Atlantic salmon recovery in the watershed.
- Open pen aquaculture is the single most reason for the decline of Bay of Fundy salmon!!!!

6.3.2 Open House

Two open house sessions were held in two locations within the watershed, giving people the opportunity to drop in if they had the chance, and talk one-on-one with a staff member. An advertisement poster was created for the event that was held in conjunction with another CARP project (Appendix J). Posters were distributed to several communities throughout the watershed, from Annapolis Royal to Ayelsford (Appendix K). It was also sent out electronically to the Lions Clubs in Annapolis Valley, as well as posted on the CARP Facebook page. These events were also advertised on 3 local radio stations, AVR 97.7, Magi 94.9 and 89.3 K-Rock (Appendix L). Open houses had poor attendance, with 4 people in attendance at the first and 0 at the second.

6.3.3 Presentations

A presentation on the Atlantic salmon habitat restoration management plan was also given at the local Recreational Fisheries Advisory Council Meeting (RFAC 5), at the NSCC Kingstec campus in Kentville on November 15, 2012. Twenty-seven people were in attendance at this meeting. Each attendee was given a survey; however, only one survey was returned.

6.3.4 Nova Scotia Fishing Forum

Another form of public outreach came from posts made on the Nova Scotia Fishing Forum (www.novascotiafishing.com), linking forum members to the online survey, as well as asking for forum members to provide information they had on salmon in the watershed. The initial thread was created and added to two boards – Gone Fishing and Salmon Fishing, on December 11, 2012. By January 11th, the posts had been viewed a total of 494 times, had received 8 comments and generated at least 4 completed surveys.

6.3.5 Comments and Stories

Over the course of December 2012 and January 2013, valuable information was collected through an interview with a member of the local community, as well as through the Nova Scotia Fishing Forum. This information has provided good local knowledge on the state of Atlantic salmon populations in the Annapolis River watershed before and after the installation of hydroelectric and tidal power dams within this system. All of the information in the following sections captures a traditional knowledge, history and potential timeline for the rise and fall of Atlantic salmon in the Annapolis River watershed.

6.3.5.1 Interview with Earle Saunders

Earle Saunders, a local resident of over 70 years, grew up along the banks of the Nictaux River, and believes that Atlantic salmon populations in the Nictaux River were destroyed because of hydro dams. He recounts that even back in the 1930's and 1940's, when the Town of Middleton built the first big power dam on the Nictaux River, that they made provisions and built a fishway. Earle remembers as a child going down to the dam during the day when the water was building up, that you could see hundreds of salmon lying underneath the edge of the dam, and when the water rose high enough, they would start jumping over the dam. Back then only 1 salmon was ever brought home at a time.

During the 1950's, Nova Scotia Power bought the dam from the Town of Middleton, and decided to build a bigger (90 foot) dam further upstream on the Nictaux River. An underground pipe runs from the canal to the original powerhouse. However this time, no provisions were made for fish passage – fish no longer had the ability to migrate further upstream.

Over time, the fishway at the original dam had deteriorated and fish were no longer able to get up past that – their upstream migration route had been substantially reduced. In an attempt to remediate this, an old truck was stationed at the original dam and the salmon that attempted to move upstream through the fishway were loaded into the truck and transported further up the Annapolis River and dumped into the river at Wilmot. This was not successful due to the salmon's site fidelity, as they began migrating back to the Nictaux River.

Over time, fewer and fewer salmon were coming up the river, and eventually they just stopped. In Earle's opinion, unless something is done to regulate the water level between the dams on the Nictaux River, it will be impossible to bring the salmon back to this river. He thinks that the only chance the salmon might have is in the Black River, which is further upstream along the Annapolis River. See Appendix M for a full transcript of the recorded portion of the interview.

6.3.5.2 Comments from the Nova Scotia Fishing Forum

More local knowledge of Atlantic salmon came from the Nova Scotia Fishing forum. A commenter who grew up in Lawrencetown remembers that tributaries such as Finney's Brook, Nursery Brook and Gehues Brook were once home to Atlantic salmon. He remembers huge fluctuations in water levels from spring to summer, when the river would all but dry up, eliminating critical salmon habitat, after the installation of the 90 foot dam on the Nictaux River. He also recounts that salmon were still being landed in the Round Hill Brook, but only until the tidal power plant was installed. He stated, "The Annapolis River runs cleaner and still has a healthy run of shad and brook trout but because of hydroelectricity production this poor river is a shadow of its historic self". See Appendix N for the full comment from the Nova Scotia Fishing forum.

The final series of comments provides accounts of salmon spawning and the presence of salmon parr in the Fales River, near Greenwood, upstream of both the Nictaux River and Black River. There is a waterfall on this system, which was possible one of the first hydroelectric turbines in the province. It is no longer in commission, but it is possible that this waterfall is a barrier to fish passage. See Appendix O for the full series of comments on this topic from the Nova Scotia Fishing forum.

7.0 Recommendations

1. Although the Atlantic salmon management plan is a working document, it is recommended that further field work such as more fish population surveys (minnow traps, electrofishing, seining, fyke netting), habitat suitability surveys and water quality analyses are completed in order to gather a better data set for the Black River sub-watershed.

2. Water quality assessments should be completed at designated sites along the Black River over an entire field season. In 2012, water quality assessments were not done regularly, and coincided with culvert assessments, fish population surveys and habitat suitability assessments. Water quality assessments were not completed during all culvert assessments due to low water levels during the summer.

3. Additional fish population surveys should be completed along the Black River. Electrofishing surveys should be done in spring and fall, when water temperatures are suitable, while other fish sampling methodologies, such as minnow traps, seine netting and fyke netting can be done in the summer months.

4. Habitat suitability assessments should be completed along stretches of the Black River closer to its confluence with the Annapolis River, as well as towards the headwaters.

5. Digger logs and deflectors were installed along a 2 km portion of the Black River in the early 1990's by CARP (CARP 1995). The last recorded maintenance inspection was July 1996. No UTM coordinates were recorded; however, it is unknown when these structures last received a regular maintenance check, and should be looked at to ensure they are functioning properly.

6. Gathering more traditional knowledge through surveys, interviews and public meetings is an important component of creating these management plans. Obtaining this information provides some historical knowledge of the state of these systems and their fish populations, as well as creates a timeline for any changes. In 2012, survey's provided the most general information for the project. Conducting one-on-one interviews or sitting down with a few local individuals also proves to be beneficial to obtaining more detailed and specific information. The Nova Scotia Fishing forum is also a good avenue for getting a conversation going and letting people know what kind of work is being done, and what kind of information is being looked for. Using a combination of these methods allows for a broader range of information to be gathered. The most important part is engaging the public; getting them interested and involved.

7. Due to the quantity of data that is required for both *Broken Brooks* and the Atlantic salmon habitat restoration management plan, these projects could be separated from one another with separate project

leaders, so as to ensure that adequate data is being collected for each project individually. Although culvert assessments are an important component of the data collection process of the management plan, by employing separate project leaders, more time could be allocated to conducting fish population surveys, fish habitat quality and water quality assessments.

8.0 References

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The Outlook. May 13, 1910.

The Outlook. May 12, 1916.

Appendices

Appendix A: Culvert Assessment Data Sheet

CARP Culvert Assessment Data Sheet

Field Crew: ____

Site Information			
Culvert ID		Date (dd/mm/yyyy)	
Stream Name		Time	
Road Name		UTM Easting (m)	
Fish Habitat	☐ YES ☐ NO	UTM Northing (m)	
Photo Files	☐ U/S ☐ Inflow ☐ D/S ☐ Outflow ☐ Other	Air Temperature (°C)	
Debris Present/ Description of Debris Blockage	☐ Yes ☐ No Description:		
Ownership of Barrier	☐ Public Road ROW	☐ Rail Bed ROW	☐ Private

*If culvert is identified as being located on a fish bearing stream, then proceed with further data collection.

Water Quality (upstream of culvert)							
pH		DO (mg/L)		Conductivity (mS/cm)		Salinity (g/L)	
Water Temp (°C)		DO (% SAT)		Turbidity (NTU)		TDS (mg/L)	

Culvert Information					
Culvert Shape	☐ Circular ☐ Box ☐ Pipe Arch ☐ Double ☐ Open Arch ☐ Other	Entrance Type	☐ Projecting ☐ Headwall ☐ Mitered ☐ Wingwall ☐ Other	Culvert Material	☐ Concrete ☐ CMP (spiral) ☐ CMP (annular) ☐ Corrugated Plastic ☐ Wood ☐ Other
Baffles	☐ Present ☐ Absent	Culvert Bottom Material	☐ Natural ☐ Unnatural ______________ ☐ Substrate ______________		
Notch Width (m)					
Notch Depth (m)					

Embedded		
(Check the box that applies and note depth of embedment or percent of embedment)	1) <30cm or > 20% culvert diameter & continuous	
	2) <30cm or <20% culvert diameter but continuous or partial	
	3) No embedment or discontinuous	

Additional Information			
Inflow Drop	☐ YES ☐ NO	Backwatered (%)	0 25 50 75 100
Beaver Activity	☐ YES ☐ NO	Fish Present (Type & #)	

Channel Measurements (Taken upstream of culvert)				
	Pool	Riffle	Run	
Wetted Width (m)	1	2	3	AVERAGE
Bankfull Width (m)	1	2	3	AVERAGE
Culvert Width (m)				
Stream Width Ratio (SWR)	SWR = Average Bankfull Width / Culvert Width			

Culvert Dimensions				
[2] Culvert Measurements (m)	WIDTH	HEIGHT	[1] Water Depth in Culvert (cm)	
[2] Corrugation (cm)	WIDTH	HEIGHT	[1] Water Velocity in Culvert Inflow (m/s)	
[2] Wetted Measurements (cm)	WIDTH	DEPTH	[2] Water Velocity in Culvert Outflow (m/s)	
[2] High Water Mark (cm)	WIDTH	DEPTH		

Outflow Drop (refer to manual for locations of measurements)					
	HI (m)	FS (-)	Elevation (m)	Outflow Drop (cm)	OD = Elevation at Outflow Invert – Elevation at Tailwater
2 Elevation at Outflow Invert					
4 Elevation at Tailwater (1st Riffle)					

Culvert Slope					
	HI (m)	FS (-)	Elevation (m)	Slope (%)	Slope = Elevation Inflow (m) – Elevation Outflow (m) / Culvert Length (m)
1 Elevation at Inflow Invert					
2 Elevation at Outflow Invert					
1-2 Culvert Length (m)					

Channel Slope							
Outflow	HI (m)	FS (-)	Elevation (m)	Inflow	HI (m)	FS (-)	Elevation (m)
2-4 Distance from culvert to 1st riffle				1-6 Distance from culvert to 1st Riffle			
4 Outflow Elevation at 1st Riffle (Tailwater)				6 Inflow Elevation at 1st Riffle			
4-5 Distance from 1st Riffle to 2nd Riffle				** Upstream Channel Slope (%)			
5 Outflow Elevation at 2nd Riffle				*Downstream Channel Slope = (Elevation at 1st Riffle – Elevation at 2nd Riffle) / Distance from 1st Riffle to 2nd Riffle			
* Downstream Channel Slope (%)							
3 Pool Bottom Elevation				**Upstream Channel Slope = (Elevation at 1st Riffle Upstream – Elevation at Inflow Invert) / Distance from Culvert Inflow to 1st Riffle Upstream			
Pool Depth (m)				Notes:			
Pool Surface Elevation (m) (Pool Bottom Elevation + Pool Depth)							

Tailwater Cross Section (Facing downstream starting at left bankfull ending at right bankfull divide stream into six even sections and measure depth)						
Station (m)	HI (m)	FS (-) (m)	Elevation (m) [HI – FS]	Water Depth (m)	Velocity (m/s)	Substrate Size Class (taken upstream in percentage composition, total 100%)
Left Bankfull						<0.3 fines (silt/sand) :
						0.31-0.7 fine gravel :
						0.71-2.5 medium gravel :
						2.51-6 coarse gravel :
						6.01- 40 cm (cobble) :
						>40cm (boulder) :
Right Bankfull						Bedrock :

Notes & Sketch:

Appendix B: Multiple Culvert Assessment Data Sheet

CARP Multiple Culvert Assessment Data Sheet

Site Information				
Culvert ID				
Photo Files	☐ U/S ☐ Inflow ☐ D/S ☐ Outflow ☐ Other	Debris Blockage	☐ YES	☐ NO
Description of Debris Blockage				

Culvert Information					
Culvert Shape	☐ Circular ☐ Box ☐ Pipe Arch ☐ Double ☐ Open Arch ☐ Other	Entrance Type	☐ Projecting ☐ Headwall ☐ Mitered ☐ Wingwall ☐ Other	Culvert Material	☐ Concrete ☐ CMP (spiral) ☐ CMP (annular) ☐ Corrugated Plastic ☐ Wood ☐ Other
Baffles	☐ Present ☐ Absent	Culvert Bottom Material	☐ Natural ☐ Unnatural ______________________ ☐ Substrate ______________________		
Notch Width (m)					
Notch Depth (m)					

Embedded		
(Check the box that applies and note depth of embedment or percent of embedment)	1) <30cm or > 20% culvert diameter & continuous	
	2) <30cm or <20% culvert diameter but continuous or partial	
	3) No embedment or discontinuous	

Additional Information			
Inflow Drop	☐ YES ☐ NO	Backwatered (%)	0 25 50 75 100

Culvert Dimensions				
[2] Culvert Measurements (m)	WIDTH	HEIGHT	[1] Water Depth in Culvert (cm)	
[2] Corrugation (cm)	WIDTH	HEIGHT	[1] Water Velocity in Culvert Inflow (m/s)	
[2] Wetted Measurements (cm)	WIDTH	DEPTH	[2] Water Velocity in Culvert Outflow (m/s)	
[2] High Water Mark (cm)	WIDTH	DEPTH		

Outflow Drop (refer to manual for locations of measurements)					
	HI (m)	FS (-)	Elevation (m)	Outflow Drop (cm)	OD = Elevation at Outflow Invert – Elevation at Tailwater
[2] Elevation at Outflow Invert					
[4] Elevation at Tailwater (1st Riffle)					

Culvert Slope					
	HI (m)	FS (-)	Elevation (m)	Slope (%)	Slope = Elevation Inflow (m) – Elevation Outflow (m) / Culvert Length (m)
[1] Elevation at Inflow Invert					
[2] Elevation at Outflow Invert					
[1-2] Culvert Length (m)					

Channel Slope							
	HI (m)	FS (-)	Elevation (m)		HI (m)	FS (-)	Elevation (m)
[2] Elevation at Outflow Invert				[1] Elevation at Inflow Invert			
[2-4] Distance from culvert to 1st riffle				[1-6] Distance from culvert to 1st Riffle			
[4] Outflow Elevation at 1st Riffle (Tailwater)				[6] Inflow Elevation at 1st Riffle			
* Downstream Channel Slope (%)				** Upstream Channel Slope (%)			
[3] Pool Bottom Elevation				*Downstream Channel Slope = (Elevation at 1st Riffle – Elevation at 2nd Riffle) / Distance from 1st Riffle to 2nd Riffle **Upstream Channel Slope = (Elevation at 1st Riffle Upstream – Elevation at Inflow Invert) / Distance from Culvert Inflow to 1st Riffle Upstream			
Pool Depth (m)							
Pool Surface Elevation (m) (Pool Bottom Elevation + Pool Depth)							

Notes & Sketch:

Appendix C: Bridge Assessment Data Sheet

CARP Bridge Assessment Data Sheet

Field Crew: ____

Site Information				
Culvert ID			Date (dd/mm/yyyy)	
Stream Name			Time	
Road Name			UTM Easting (m)	
Fish Habitat	☐ YES ☐ NO		UTM Northing (m)	
Photo Files	☐ U/S ☐ Inflow ☐ D/S ☐ Outflow ☐ Other		Air Temperature (°C)	
Debris Blockage/ Description of Debris Blockage	☐ YES ☐ NO Description:			
Ownership of Barrier	☐ Public Road ROW	☐ Rail Bed ROW		☐ Private

*If culvert is identified as being located on a fish bearing stream, then proceed with further data collection.

Water Quality (upstream of culvert)							
pH		DO (mg/L)		Conductivity (mS/cm)		Salinity (g/L)	
Water Temp (°C)		DO (% SAT)		Turbidity (NTU)		TDS (mg/L)	

Field Crew: ____

Site Information				
Culvert ID			Date (dd/mm/yyyy)	
Stream Name			Time	
Road Name			UTM Easting (m)	
Fish Habitat	☐ YES ☐ NO		UTM Northing (m)	
Photo Files	☐ U/S ☐ Inflow ☐ D/S ☐ Outflow ☐ Other		Air Temp (°C)	
Debris Blockage	☐ YES ☐ NO Description of Blockage:			
Ownership of Barrier	☐ Public Road ROW	☐ Rail Bed ROW		☐ Private

*If culvert is identified as being located on a fish bearing stream, then proceed with further data collection.

Water Quality (upstream of culvert)							
pH		DO (mg/L)		Conductivity (mS/cm)		Salinity (g/L)	
Water Temp (°C)		DO (% SAT)		Turbidity (NTU)		TDS (mg/L)	

Field Crew: ____

Site Information				
Culvert ID			Date (dd/mm/yyyy)	
Stream Name			Time	
Road Name			UTM Easting (m)	
Fish Habitat	☐ YES ☐ NO		UTM Northing (m)	
Photo Files	☐ U/S ☐ Inflow ☐ D/S ☐ Outflow ☐ Other		Air Temp (°C)	
Debris Blockage	☐ YES ☐ NO Description of Blockage:			
Ownership of Barrier	☐ Public Road ROW	☐ Rail Bed ROW		☐ Private

*If culvert is identified as being located on a fish bearing stream, then proceed with further data collection.

Water Quality (upstream of culvert)							
pH		DO (mg/L)		Conductivity (mS/cm)		Salinity (g/L)	
Water Temp (°C)		DO (% SAT)		Turbidity (NTU)		TDS (mg/L)	

Appendix D: List of All Culverts Assessed in 2012

Culvert ID	Stream Name	Road Name	Ownership	Easting (m)	Northing (m)	Outflow Drop (cm)	Slope (%)	Problems	Recommendations	Notes
BLK004	Black River	HWY 201	Public (ROW)	340265	4978857	4.5	0.94	Slope	Tailwater control	Two digger logs are present downstream of the culvert. As of the end of the summer there is a beaver dam near the tailwater control.
BLK034	Black River	Messenger Rd	Public (ROW)	347103	4978081	-0.6	-1.28			Water level very low; brook trout trapped in pool within culvert
BLK011	Black River	HWY 201	Public (ROW)	340407	4978776	-2.6	-3.07			
BLK006	Black River	Meadowvale Rd	Public (ROW)	344041	4978760	39.8	-0.08	Outflow drop	Removal of structure	Broken piece of wood at outflow; sand bar built up downstream
BLK039	Black River	Messenger Rd	Public (ROW)	347630	4978515	33.1	7.24	Outflow drop Slope	Removal of structure	Barbed wire fence across the downstream side of the stream – couldn't measure tailwater control
BLK037	Black River	Messenger Rd	Public (ROW)	349362	4978300	77.3	1.05	Outflow drop Slope	Removal of structure	
BLK047	Black River	Torbrook Rd	Public (ROW)	343873	4978631	32.5	0.84	Debris Outflow drop Slope	Debris removal; tailwater control	Sediment build up around a tree stump situated between the inflow mouth of culverts; upstream = sand/silt, downstream = cobble/gravel; upstream leads to a swamp; lots of branches downstream; tailwater control structure may be possible
BLK038	Black River	East Torbrook Rd	Public (ROW)	348232	4976907	52.1	2.92	Outflow drop Slope	Removal of structure	Culvert bottom on inflow side is rusted out; there are some large boulders and branches on the outflow side
BLK036	Black River	East Torbrook Rd	Public (ROW)	347589	4976593	-2.1				
SPI003	Spinney Mountain Brook	East Torbrook Rd	Public (ROW)	346566	4975970	134.2	0.62	Outflow drop Slope	Removal of structure	Water flow into the culvert and then down through spaces in the boards and continues flow under the culvert; downstream is great brook trout habitat
BLK021	Black River	East Torbrook Rd	Public (ROW)	344123	4975200	105.3	-6.23	Outflow drop	Removal of structure	At low flow water runs under the culvert; water may flow through it at times of high flow
BLK019	Black River	Whitman Br	Public (ROW)	343858	4975276	-39.7		Debris	Debris removal	Sand bar just upstream of culvert – can no longer see the stream bottom; lots of braches literring the upstream habitat; looks like it has been a garbage dumping ground in the past.
BLK022	Black River	Torbrook Rd	Public (ROW)	344004	4975456	0.1	1.42	Rock debris Slope	Debris removal; baffle installation and tailwater control	Upstream measurements were not possible – hard to distinguish upstream habitat features.
MED004	Meadow Brook	East Torbrook Rd	Public (ROW)	346480	4975922	183.5	1.93	Outflow drop Slope	Removal of structure	Downstream is a good brook trout habitat as indicated by the landowner beside the stream.
MED003	Meadow Brook	Fire Lane	Public (ROW)	346371	4975363	-44.7	1.56	Slope	Tailwater control	Upstream habitat is very overgrown.
BLK016	Black River	Uhlman Br	Public (ROW)	343205	4974348	55.4	1.38	Outflow drop Slope	Removal of structure	Culvert material changes halfway inside the culvert; inflow side is CMP, outflow side is corrugated plastic.
BLK049	Black River	Allen Lake Rd	Public (ROW)	343383	4971969	23.3	3.07	Outflow drop Slope	Baffle installation and tailwater control	Trees upstream of the culvert have been cut down and are littering the upstream habitat.

Culvert ID	Stream Name	Road Name	Ownership	Easting (m)	Northing (m)	Outflow Drop (cm)	Slope (%)	Problems	Recommendations	Notes
MED001	Meadow Brook	Off Allen Lake Rd	Public (ROW)	343352	4972275	-8.8		Debris	Debris removal	Culvert bottom on inflow side is rusted out; two culverts on outflow side, only one on inflow side; partial rusted culvert sitting on stream bank.
BLK013	Black River	Bloomington Rd	Public (ROW)	342263	4970757	28	0.019	Debris	Debris removal	Large debris/sediment build up at inflow grate; beaver dam built in outflow mouth.
BLK051	Black River	Bloomington Rd	Public (ROW)	342281	4970723	-0.1	-1.43	Debris	Debris removal	Large debris/sediment build up at inflow grate; branches building up inside culvert – not restricting water flow yet, but should be looked at in the future.
BLK033	Black River	Messenger Rd	Public (ROW)	347011	4979352	4.2	0.26			
BLK041	Black River	Tremont Rd	Public (ROW)	347497	4979430		0.90	Slope	Tailwater control	Water does not appear to be flowing through this culvert very well; upstream runs along a horse field; algae bloom present.
NIC004	Nictaux River	HWY 201	Public (ROW)	339624	4977744	30.2	6.30	Outflow drop Slope	Removal of structure	
NIC003	Nictaux River	HWY 201	Public (ROW)	339426	4977464	6.9	4.21	Debris Outflow drop Slope	Debris removal; baffle installation and tailwater control	Culvert used to be part of an old fish hatchery; downstream runs through home owners property; upstream is very muddy.
NIC002	Nictaux River	HWY 201	Public (ROW)	339410	4977432	12.5	2.11	Debris Slope Velocity*	Debris removal; tailwater control	Upstream forks – one branch runs alongside road into quarry, the other branch is connected to a swampy area by another culvert; large rock at inflow mouth; water velocity downstream could become an issue if inflow grate at upstream culvert (NIC028) is removed.
NIC028	Nictaux River	HWY 201	Public (ROW)	339403	4977420	19.8	0.14	Debris Outflow drop	Debris removal; tailwater control	Inflow grate has large debris build up restricting water flowing through culvert; feeds directly into NIC002
NIC010	Nictaux River	Bloomington Rd	Public (ROW)	341031	4973625	2.2	0.91	Debris Slope	Debris removal; tailwater control	Upstream is a muddy swamp – upstream measurements were not taken.
NIC014	Nictaux River	Bloomington Rd	Public (ROW)	341534	4972368	10.6	-0.63	Outflow drop	Tailwater control	Fence blocking access to upstream habitat.
NIC011	Nictaux River	HWY 10	Public (ROW)	339506	4971966	66.1	1.93	Outflow drop Slope	Removal of structure	Upstream is dried up but there is water downstream.
NIC012	Nictaux River	Neily Rd	Public (ROW)	338968	4972040	-9	1.01	Debris Slope	Debris removal	Beaver dam built at tailwater control – sediment build up around dam; water could flow through dam during periods of high flow; upstream is a swamp habitat.
KEM002	Kempt Brook	HWY 201	Public (ROW)	337170	4975730	2.37	1.47	Slope	Tailwater control	Culvert is concrete in the middle and wooden at inflow/outflow mouths; culvert turns approximately 30° in the center
BEZ004	Bezant Lake Brook	HWY 10	Public (ROW)	345302	4952379	8.9	0.16	Outflow drop	Tailwater control	
BEZ005	Bezant Lake Brook	Off HWY 10	Public (ROW)	345507	4952516	2.6	2.20	Debris Slope	Debris removal; tailwater control	Upstream channel is very deep and leads to a swamp; grate at both inflow/outflow mouths.
BEZ002	Bezant Lake Brook	Off HWY 10	Public (ROW)	342949	4951627	0.59	_	_	_	Located down a road that is not well maintained; did not get culvert length

Culvert ID	Stream Name	Road Name	Ownership	Easting (m)	Northing (m)	Outflow Drop (cm)	Slope (%)	Problems	Recommendations	Notes
NIC017	Tributary to Nictaux River	HWY 10	Public (ROW)	341824	4954199	-2.9	-0.09	Debris	Debris removal	Beaver dams built at tail of outflow pool and at inflow mouth; dams were removed and site revisited to re-take measurements; beaver dam downstream being re-built.
NIC018	Tributary to Nictaux River	Off HWY 10	Public (ROW)	341850	4954251	1.9	12.08	Slope	Removal of structure – culvert is collapsed	Upstream leads to a swamp; downstream flows into NIC017; culvert is completely collapsed.
NIC024	Tributary to Nictaux River	Off Old Liverpool Rd	Public (ROW)	339416	4945770	19	-1.84	Debris Outflow drop	Debris removal; tailwater control	Beaver dam built inside of culvert
NIC030	Tributary to Nictaux River7	Old Liverpool Rd	Public (ROW)	340273	4951524	9.7	-0.07	Debris	Debris removal	System of 3 culverts; two main culverts are side-by-side with a large inflow grate, third culvert is further away; inflow grate extremely clogged; third culvert has a beaver dam built in the inflow mouth; not a lot of water flowing through.
OAK007	Oakes Brook	HWY 10	Public (ROW)	337261	4960139	-0.11	-0.39			No debris blockage but the water is not moving; upstream is swampy; large rocks downstream
OAK009	Oakes Brook	Adam's Rd	Public (ROW)	337365	4959200	30.7	0.52	Outflow drop Slope	Removal of structure	Upstream is a swamp; small foot bridge on the downstream side that hasn't been used in years (overgrown with trees).
BEL005	Beal's Brook	Eves Rd	Public (ROW)	337060	4958051	7	-0.08	Outflow drop	Tailwater control	Based on information given by a local resident, when water is high, everything floods – this happens upstream mostly because the culvert is too small to handle that much water; an old rainbow trout hatchery is located just downstream of the culvert.
OUT002	Tributary to Nictaux River	Broad Lake Rd	Public (ROW)	336888	4960282		-1.89			
OAK006	Oakes Brook	HWY 10	Public (ROW)	337128	4961560	-52.8	1.46	Slope	Tailwater control	Beaver dam located just upstream of culvert where it opens up into a large swamp.
OAK005	Oakes Brook	HWY 10	Public (ROW)	337209	4963508	-31.9	-0.24			
KEL012	Kelly's Brook	West Dalhousie Rd	Public (ROW)	337233	4951353	-87.9	3.29	Slope	Removal of structure	
KEL006	Kelly's Brook	Che-Boag-a-Nish Rd	Private	337809	4954608		-0.20			Culvert needs to be revisited – a large vehicle crushed it during the winter of 2012 and should be replaced by September; upstream habitat is a lake that is stocked by DNR with speckled trout; Scouts Canada camp; it is not blocked completed so fish are still able to pass through it.

Appendix E: High Priority Culverts

Priority	Culvert ID	Stream Name	Easting (m)	Northing (m)
1	BLK011	Black River	340407	4978776
2	BLK004	Black River	340265	4978857
3	BLK047	Tributary to Black River	343873	4978631
4	NIC030	Tributary to Nictaux River	340273	4951524
5	KEL012	Kelly's Brook	337233	4951353
6	BLK006	Tributary to Black River	344041	4978760
7	MED001	Meadow Brook	343352	4972275
8	MED003	Meadow Brook	346371	4975363
9	BLK034	Tributary to Black River	347103	4978081
10	KEM002	Kempt Brook	337170	4975730
11	BLK037	Tributary to Black River	349362	4978300
12	SPI003	Spinney Mountain Brook	346566	4975970
13	NIC003	Tributary to Nictaux River	339426	4977464
14	OAK007	Oakes Brook	337261	4960139
15	NIC024	Tributary to Nictaux River	339416	4945770
16	KEL006	Kelly's Brook	337809	4954608

Appendix F: Medium Priority Culverts

Priority	Culvert ID	Stream Name	Easting (m)	Northing (m)
1	BEZ002	Bezant Lake Brook	342949	4951627
2	BLK033	Tributary to Black River	347011	4979352
3	OUT002	Unknown	336888	4960282
4	BLK013	Tributary to Black River	342263	4970757
5	BLK051	Tributary to Black River	342281	4970723
6	BLK036	Tributary to Black River	347589	4976593
7	OAK005	Oakes Brook	337209	4963508
8	MED004	Meadow Brook	346480	4975922
9	NIC011	Tributary to Nictaux River	339506	4971966
10	BLK041	Tributary to Black River	347497	4979430

Appendix G: Low Priority Culverts

Priority	Culvert ID	Stream Name	Easting (m)	Northing (m)
1	BLK049	Tributary to Black River	343383	4971969
2	NIC004	Tributary to Nictaux River	339624	4977744
3	BLK019	Tributary to Black River	343858	4975276
4	NIC028	Tributary to Nictaux River	339403	4977420
5	OAK009	Oakes Brook	337365	4959200
6	NIC012	Tributary to Nictaux River	338968	4972040
7	BEZ004	Bezant Lake Brook	345302	4952379
8	NIC010	Tributary to Nictaux River	341031	4973625
9	BLK039	Tributary to Black River	344041	4978760
10	BLK016	Tributary to Black River	347630	4978515
11	BLK022	Tributary to Black River	344004	4975456
12	NIC018	Tributary to Nictaux River	341850	4954251
13	OAK006	Oakes Brook	337128	4961560
14	BLK038	Tributary to Black River	348232	4976907
15	NIC017	Tributary to Nictaux River	341824	4954199
16	BEL005	Beal’s Brook	337060	4958051
17	BEZ005	Bezant Lake Brook	345507	4952516
18	NIC002	Tributary to Nictaux River	339410	4977432

Appendix H: Prioritization Table for Assessed Culverts

Culvert ID	Variable	Criterion	Score
BLK004	Number of downstream barriers	0	10
	Adjacent to main channel	Yes	5
	Upstream habitat gain	>4.5	20
		Score	**35**
BLK006	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	2 – 2.5	10
		Score	**20**
BLK039	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BLK037	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	1.5 – 2	8
		Score	**18**
BLK047	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	2.5 – 3	12
		Score	**17**
BLK038	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**7**
SPI003	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	1.5 – 2	8
		Score	**18**
BLK019	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BLK022	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**

MED004	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	0.5 – 1	4
		Score	**14**
MED003	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	2 – 2.5	10
		Score	**15**
MED001	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	2 – 2.5	10
		Score	**20**
BLK016	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BLK049	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BLK013	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	0.5 – 1	4
		Score	**14**
BLK051	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	0.5 – 1	4
		Score	**14**
BLK041	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	0.5 – 1	4
		Score	**14**
NIC004	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
NIC003	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	1.5 – 2	8
		Score	**18**

NIC002	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
NIC028	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**7**
NIC010	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
NIC011	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	0.5 – 1	4
		Score	**14**
NIC012	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**7**
KEM002	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	2 – 2.5	10
		Score	**20**
BEZ004	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BEZ005	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**7**
NIC017	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
NIC018	Number of downstream barriers	1	5
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**7**

NIC024	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	1.5 – 2	8
		Score	**18**
NIC030	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	2.5 – 3	12
		Score	**22**
OAK009	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
BEL005	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
OAK006	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	<0.5	2
		Score	**12**
KEL012	Number of downstream barriers	0	10
	Adjacent to main channel	No	0
	Upstream habitat gain	2 – 2.5	4
		Score	**14**

Appendix I: Atlantic Salmon Survey

Atlantic Salmon Survey

This survey was created by Clean Annapolis River Project to gather current and historic data on Atlantic salmon – where have they been found in the past, where they are no longer found, and how conditions in the rivers have changed – to help develop a prioritized list of sub-watersheds within the Annapolis River watershed to create Atlantic salmon habitat management plans.

1. What County do you reside in?

2. Do you fish in any rivers or streams within Annapolis/Kings County?

   ☐ Yes ☐ No

3. If you answered 'Yes' to Question 2, which rivers/streams do you fish in?

   ☐ Nictaux River
   ☐ Black River
   ☐ Other: ____________________
   ____

4. Have you ever caught an Atlantic salmon as bycatch?

   ☐ Yes ☐ No

5. If you answered 'Yes' to Question 4, what age class was caught?

   ☐ Parr (< 5 inches) ☐ Smolt (5-6 inches) ☐ Adult (>6 inches)

6. Which rivers/streams have you observed Atlantic salmon in the past?

7. What do you think are the primary issues that have contributed to the decline of Atlantic salmon?

8. Have you noticed any changes in the condition of these rivers/streams?

☐ Yes ☐ No

9. If you answered 'Yes' to Question 8, please identify these changes.

10. Do you have any other comments or concerns?

Contact Information

Please provide your contact information if you are interested in discussing this matter further, or if you have additional information to provide. Any contact information provided will remain confidential.

Name:
Phone Number:
Email:

Appendix J: Advertising Flyer for Open Houses

Bring Back the Salmon!

Clean Annapolis River Project is in the process of developing a habitat restoration management plan for Atlantic salmon in the Black River and Nictaux River subwatersheds.

We need YOUR help!

We are looking for:

- How conditions in these rivers have changed over time
- Where have you seen Atlantic salmon?
- Catch records – have you caught an Atlantic salmon here in the past?

&

Protect the Nictaux!

Come out and support the protection of the Nictaux River land parcel under Nova Scotia Environment's 12% by 2015 campaign.

Drop in and learn more about the campaign and voice your opinion by:

- Filling out a survey
- Signing a call to action
- Signing a pre-existing letter of support
- Writing your own letter of support

Drop in and see us!

Tuesday November 27, 2012
Anytime between 2-7 pm
Middleton Lions Club
8921 HWY 10, Nictaux

Thursday November 29, 2012
Anytime between 5-8pm
CARP Office
151 Victoria St., Annapolis Royal

Clean Annapolis River Project
(902) 532-7533
1-888-547-4344

kristenwagner@annapolisriver.ca
carolynhann@annapolisriver.ca

Appendix K: Flyer Locations

Community	Poster Location
Annapolis Royal	The Cozy Internet Café
	Pharmasave
	Annapolis Variety
	Community Board outside Police Station
	Annapolis Royal Laundromat
	Scotiabank
	Community Board outside Kings Theatre (x2)
	Ye Olde Towne Pub
	NSLC
	Foodland
	Home Hardware
	Save Easy
	Annapolis Royal Post Office
	Clean Annapolis River Project Office
Aylesford	Aylesfod Post Office
Greenwood	Avery's Farm Market
	Sobey's
	Canadian Tire
	Greenwood Mall (x2)
Kingston	Avery's Farm Market
	Kingston Post Office
Lawrencetown	Kwik Way
Middleton	Town Hall
	Community Board outside Town Hall
	Community Board outside Save Easy
	Home Hardware
	Subway
	Pharmasave
	Bean Roasted Café
	The Capitol Pub
	Save Easy
	Hair Hunters
	Pizza Factory
	Used Book Store
	Middleton Post Office
	King Size Pizza
	Kwik Way
	Big Scoop
	Avery's Farm Market
Nictaux	Needs (x2)
Wilmot	Guy Frenchy's (x2)
	Kwik Way

Appendix L – Radio Station Advertisements and Dates for Open Houses

Radio Station	Website	Type of Advertisement	Date Run
AVR 97.9	www.avrnetwork.com	Radio	Week of November 19 and 26
		Events page of website	Week of November 19 and 26
Magic 94.9	www.magic949.ca	Radio	Week of November 19 and 26
		Events page on website	Week of November 19 and 26
89.3 K-Rock	www.k-rock893.com	Radio	Week of November 19 and 26
		Events page of website	Week of November 19 and 26

Appendix M: Interview with Earle Saunders on Atlantic Salmon History in the Annapolis River Watershed

Earle (E) (local fisherman): Back in the 30s and 40s, people seemed to care more about their river, because they needed power; Middleton, the town of Middleton needed power, and so they decided to build a power dam. And they built a power dam at Nictaux.

Kristen (K) (CARP staff): Oh, okay, so it was Middleton who built it.

E: And it was an old wooden dam over there on the river. And they built a canal system of a very short run of pipe which ran into the powerhouse. And obviously it did not produce enough power, for long term, but at least it gave lights. And other than that there were only a few little sawmills and things like that on the river. You've probably visited the power dam where the old powerhouse used to be.

K: On Torbrook Road?

E: No, this is the one on, just over in Nictaux, where you go over to the firehall, turn left, go East, and it used to be called 'Rogers Dam' – 'Martin's Mill'…

K: Oh okay, yeah I've heard about it, and I've talked to the guy who owns the land around it, but I've never been there.

E: Well they, a few years ago, a group got together and somehow financed a fishway there. So that fish could get up over it. There are no fish to go up over it, but…

K: It was there…

E: That came out in the spring in a freshet, where the ice melted and took the dam out. So that took fishway and all. But that's the best thing that ever happened really.

K: Removing it?

E: Because initially there was no dam on that river until they built the mill. Even then they put a fishway in so the salmon could get up. The only thing that couldn't get up were shad, shad couldn't get up. But the seat trout, there was a sea trout run in the last week of June, first week of July, and they were able to go up. So you caught sea trout all up through. At the Nictaux power dam, which is up further, and I think you've probably seen it, you can see it from Nictaux Falls side, that dam was put in there, so as to store water during the day time. At night they needed power; so they stored up all of this water during the day, opened up the powerhouse and run the water through. By morning the water was pretty well gone, so there was no water going over the dam at all. But it used to build up, build up during the day when they shut the powerhouse off. And then towards, oh probably, 3, 4 o'clock in the afternoon, the water started slopping over the dam. Now they had a fishway – see, they even built fishways back then, and the salmon used to go up the fishway, all kinds of salmon, and trout. But still, there were a lot of salmon that jumped over the dam, when this water started splashing over. And as a small kid, I remember my brothers, who were older than I. My mother would want a salmon for dinner. And they wouldn't go down until 11 to get the salmon. Because the water was shut off during the day. So they water went down and the salmon would be laying underneath the edge of this dam. And you could walk out on the edge of the dam and see these salmon laying

there, with their tails fanning, and just hundreds of them. Never thought of using a rod to catch a salmon in those days, because there were just hundreds of them. There were two runs, one in the spring, and then one in the fall, called an August run. The smaller ones came up in the spring, I think they were all female fish, and the male fish came up in the fall. So I remembered what they used to do, and we were only ever allowed one salmon – if we ever brought a second salmon home, I don't know what would have happened to us.
K: Was that just what your parents said?

E: Oh yeah. Most people around were about the same way.

K: That was the norm at the time?

E: Oh yes, except in the fall. In the fall when the second run came up, in August or September, or somewhere in that area, we were allowed to get 3. That was a big day!

K: Yeah, I bet.

E: And my mom would bottle them up and put them down for winter. Now the salmon weren't large salmon. Not like you hear in Cape Breton or Newfoundland. They were salmon that weighed, probably the biggest one I ever saw was 14 pounds. And I don't remember anybody catching grilse. I don't know if that's another breed of salmon or whatever, but you'd hear that there were grilse all the time. And I always thought it was just a small salmon, but apparently it's a species outside… you know there's grilse and then there's bigger salmon. I don't know that for sure.

K: I could look that up. I can't remember off the top of my head. It has to do with how many winters they spend in the ocean. Something like that.

NOTE: Grilse are salmon that return to freshwater after only one year at sea.

E: Well they, when the salmon spawn, my understanding is that they don't come down the river for 3 years, or something like that.

K: No, the small salmon stay in the streams for about 3 years, yeah, until they get big enough.

E: So anyway, that went on and no problem, the salmon got up over and the community ate what they wanted. And it was just at the start of oh, probably '48, '50, when people from the United States discovered the river. And they discovered that from relatives being here. And they started coming here to fish. And we used to go down and actually hook a salmon for them, 'cause they didn't know anything. You'd hook a salmon and gave them the rod, and they'd give you a whole $1. And that was a lot back then. You'd give them the rod and away they'd go and be very, very happy. And there were varied spots along the river where everybody really enjoyed fishing.

K: The better fishing spots?

E: Yeah. But anybody in the community that wanted salmon for themselves, they still never bothered with a rod. They just went down and got them. They just used a piece of cod line, a cod fish line and a broom handle, painted it red. A very large set of treble hooks, threw it in below the dam, gave it a big pull and threw the brook handle in. As we found as kids, if we didn't through the broom handle in, then you'd go in. So you threw the broom handle in and you'd follow it down the river and when you saw it out there floating, you'd wade out or swim out, whatever you

had to do. That's the way you got your salmon. Then we found that you could fish, the Americans fished with rods, and we said 'hey, that looks fun', so we started fishing with rods too. But then along came the Nova Scotia Power commission, and they bought this dam from Middleton. And they decided they needed a bigger and better powerhouse. So up at Nictaux South, they put a 90ft dam in the river, plugged the mouth and all of the water was diverted down a canal. And at the canal and underground pipe – actually it's on top for a ways and then it goes underground, and actually goes under Hwy 10, and under the riverbed.
K: The canal?

E: No, the pipe. It goes under the riverbed, and then it comes down to the powerhouse, which is in the same location as the original powerhouse. I understand that when they opened that powerhouse there were so many fish coming through that they actually did damage to the fins on the power station. Because it was just like a fish ladder. For 3 years, 3 or 4 years, the salmon kept coming down, the sea trout kept coming down. Of course as kids, we thought this was great, we would run up to the fore bay where this pipe starts and every spring, and the salmon and trout were just everywhere and you caught them and brought them home. Or you'd bring home too many and then they would spoil. You know, we ate salmon and trout, that was it.

K: Okay, so this was up at the new dam?

E: They weren't going up, they were coming down. No more could get up.

K: So it was just the ones that were already up there?

E: Plus the fact the fishway was all broken up, and not repaired for whatever reason, and the fish just couldn't get anywhere. So for several years, what they did was the Department of Fisheries – the fish ladder was in at Nictaux Falls. And they had an old truck, and they didn't know anything about fishing obviously, because they didn't know the salmon were dedicated to a river. They thought if they dumped them back in the Annapolis River they'd go up the Annapolis River. But salmon are smarter. So what they did was they loaded these salmon, they caught them in the fishway – they'd come up the fishway and they'd take these big nets and catch them, and put them in big tubs on the back of the truck. And half the time they'd jump out before they ever reached the other river. They took them up to Wilmot and dumped them in there, at Bayard's bridge.

K: That far up?

E: Oh yeah.

K: Into the Annapolis?

E: Yeah, into the Annapolis. Well they did that until they beat themselves to death, or they just died. And they kept doing it, and doing it, and doing it and the fist were all damaged. They'd come back and we'd see this one with a big gash here. And the salmon just died. And eventually no more came up. Sea trout came up as far as the Nictaux Falls dam, and they couldn't go anywhere else. And sometimes they caught those. There was a nice run of trout, in fact there still is. Anyway, the salmon just stopped coming up because they destroyed them all. Now they talk about offshore fisherman catching all these salmon and that's why there's none for the rivers. That's not true. It's a farce. There's no place to spawn, and they can't get up.

K: No, they can't get up the streams far enough to reach spawning habitat.

E: See, Nictaux, or Middleton I should say, realized that the dam couldn't hold enough water. So they went up a little further, 3 or 4 km and built another dam. I used to own that land up there.

K: Levi and I have walked from the upper dam to the lower dam and we stopped at that middle one.

E: Well they built that one, and there was also a fishway in that. So even in those days they continued to understand that fish needed to go up. But when they built the 90ft dam, there was no provision. No repair to any of the other fishways, and the salmon all died. I guess it was probably the first year that they closed the dam up that my sister and I walked up the river from the Nictaux falls dam up to the Nictaux South dam. We used to call it the new dam because it was new to us at the time. We counted 87 salmon in pools, just on the one side. There were 87, I remember and they were all in states of deterioration, because the flies got at them, there was no water. There was no water. When they cut that river off there was no water, except the little brooks and streams that came into it. A little brook that comes in maybe had more water than anything was called East Branch Brook, and it runs in the river and supplies water for awhile, but it's just runoff water. And now with the change in climate here, we don't get the snow, and we don't get the ice, and the river really gets low.

K: Oh yes.

E: I mean you can walk across it anywhere.

K: I know, Levi and I walked it middle of August, and we were pretty much walking just down the sides, down the middle if we had to, and at most it was below my knees. And we were back, doing some more work in the fall between the two dams and we went back one day and we were hiking up through the woods and we all stopped wondering what the sound was. We got to the edge and looked down and the water flowing through so fast. We walked down, but there was no way we could have gone in or we'd be floating down the river. And that was within – well the week before we were in the river.

E: And that's what happens to the fish, you know, and it's the same thing with closing. When the power commission built the dam at Nictaux South, they continued further and went to other places. McGill Lake is dammed off. Another place called the Curel(?) hole which is off, almost in West Dalhousie, toward West Dalhousie, they put a dam there. And they shut all this water off, with no provision for fish. None at all. And when the water gets down, fish die, one dam to the other, because they can't get oxygen.

K: They need water flowing through there constantly.

E: But you're never going to see that. Because with the cost of energy, they're certainly not going to take out a power station, it's not going to happen. But in the meantime of course, they thought "oh, we'll put a big dam across the Annapolis River and a big power station right in it". There goes the shad that were finally coming up. There goes the bass – the striped bass used to come all the way up where the Nictaux goes in. And we'd go right down there to catch them. And they were about a pound. And the fight! Scrappy fish, it was wonderful! But then, they couldn't go out, they couldn't go in. They could, but they don't like going through the fishway, and when they go through the power station, they get very unhappy, and so even the big striped bass that were in the Annapolis Basin, in the river right below, they couldn't live either. And people just kept catching and catching and catching. And eventually they decided that they better stop that. And I believe that if you go to that power station down there where they have some description of fish in the river, that they don't even have salmon on there. I don't think they mention salmon, they might, but I didn't see it when I was down there.

K: Which is surprising, from everything I've heard.

E: It disgusts me. So anyways, that what happened to our salmon.

K: It's so upsetting, very depressing.

E: And of course the people didn't do anything. It was early '50s that they built this big power station. There weren't a lot of jobs, it was after the war, there were no jobs anywhere. So there was only one person who ever made an issue of it ever. His name was Walter Baker, he used to be a fish warden on the river. He's been passed away a long ago. He was the only person at the time who made a real issue of it. And everybody sort of laughed at him, though 'what are you talking about? You're just out of a job' But he knew.
K: They were in denial

E: And now of course, I suppose, if the power commission would allow enough water to come down through, you might be able to direct some fish – start them up there and let them come through. But they'd have to let the water come through. Because even the shad now – the water comes up, the water goes down, the water comes up, the water goes down, the shad come in and spawn and what happens to the spawn?

K: It gets washed away.

E: Oh yeah, and then mud. Mud just destroys fish beds. Just terrible. Silt. The only other chance they might have is if they go to the Black River, which flows into the Annapolis River, and start up where I've got my camp. Start up there with some salmon fry. Because there is quite good water that goes through there at times.

K: Yes, I focused my project on the Black River this year, before we went on to the Nictaux River. And it's a beautiful river. It's fantastic.

E: Were you out my way to my camp?

K: No, we didn't go that far. Levi told me about the river up there, but we didn't go much farther than the bridge on Allen Lake Road. We did a little up. Some habitat work and electrofishing just up from that bridge. But that's as far as we went. The guy that owns most of that land up around there, as you go down to the river, you had to go left at a little small church, the last house, a friend of mine just inherited that land from his mother. David Swigger. And I don't know of any salmon ever being up that far. But I'm sure there must have been salmon fry that came up the Black River for a ways.

K: That wouldn't surprise me at all.

E: Because it dumps out at Wilmot. And goes through Torbrook Mines, and it goes back and forth a couple of times before it crosses the road before it ever gets to the Annapolis. And the head, I'm on a pretty big meadow, Peter Morris place it's called. And I'm on a big meadow, about a mile and a half, or a kilometer I guess infront of my camp, and you go through a gut, and then it's two miles of meadow. It's beautiful. And then when you go up to the top, it actually does come out at a lake, but when you go to the top of the meadow, there's white sand, and this is why I'm saying salmon might spawn there. There's whites sands and it goes through a lot of alders, and the brooks dwindles down and you can barely tell where the brook goes. And it's a horrible walk, I've never been to the lake because it's a horrible walk. And I know there must be trout up there. But a few years ago, we ad a bad summer, for 3 years in a row…

K: A dry summer?

E: Yeah, and the trout even disappeared in that brook. I hadn't seen a trout jump below my camp until last year. And I think that the fifth year. And I hadn't seen a trout jump. I had some friends that have a camp up the road, beyond my camp. They left a note this year at my camp, saying the trout were back. There must have been some trout that spawned and they came down from the lake. I'm not sure how they got there.

K: That's surprising because it was another dry summer this year.

E: Yes, and this was another bad year for it. I could walk cross that meadow anywhere. I had a beaver that had a dam on that meadow. And in fact he used to haul logs right beside my camp and used to wake me up in the middle of the night. There's lots of ledge rock and he'd be dragging some oak and it would wake me up! But anyway, that dried out terrible. There was a beaver house and the entrance to it was 7 ft between that and the brook. So you could imagine. Then the coyotes – they killed my beaver in the winter. There are several beaver on that river all the way down the Black, but that doesn't really affect fish too much, they can get up through it. They can get up underneath, but salmon, or even a big trout could jump up over.

K: Until they build them in the culverts. I've had a lot of beaver dams in culverts, completely blocking the water.

E: There's one up n Bloomington, on the way to my camp. There's a big swamp, and the beavers have the culvert closed off. In fact the guy I used to go trapping with is out there this week. He got one this week, and he'll try to get the other. There's no need for that though, because they have this device they put in culverts. It's T shaped, and made out of white plastic. It's about the same size as the culvert. But apparently when the beaver hears the water running through the culvert they try to close it off. But they put this thing just below the surface of the water. The water runs in it and down, and they don't seem to bother plugging it up. But somebody went out there and for whatever reason, took this out. So now they just have a screen over it, and so often the beavers plug it up.

K: I know exactly where you're talking about, because we were out there this summer taking out a beaver dam there. But by the sounds of it, the beaver's back and has it plugged up again.

E: Oh ya, there's no doubt about it. There's several beaver dams on that brook. As you go down that little tiny brook, before you get into the Black River.

K: That brook can't be too long before it hits the Black River.

E: Oh no, no, maybe a mile, at the most, a couple clicks. But I want a beaver out to my camp, so the meadow stays full and I'll have all kinds of trout. And I got ahold of Natural Resources and I asked them for a beaver. They asked if I was crazy, but I said no, I want my meadow dammed off so the trout will stay there. But they wouldn't take it out there. It was too far or something was wrong I guess. They called me once at 4pm saying they had a beaver, but I had to drive from Cambridge, which is ¾ of an hour drive and I told them I couldn't be there for at least 45 minutes, but they wouldn't wait for me because it was too close to quitting time. So I lost my beaver.

K: No, in some places, they are very helpful. But in other places, like culverts, not so much.

E: But the beavers were there first.

K: Exactly.

E: But the Nictaux River, unless the power commission agrees to release water, you can't do anything.

K: No, it's true. You need to come up with an agreement to keep the flow regulated.

E: They don't see the point in it. But look at the tourism value. Look at Newfoundland, look at Cape Breton, for the salmon fishing. This river was equal to any river I've ever seen in Newfoundland or Cape Breton for salmon fishing. I mean, I've seen 40 or 50 salmon jumping over that dam at the same time. Just as soon as the water slopped over, when they'd save it up during the day. The place would be alive with salmon. There were lots of ledges down below. And they used to jump up over those. And I know a guy that one time went down there when the salmon were coming up over it. And he was fishing, and he decided that he would try to catch one of these salmon that jumped up over the ledge. So we went out and stood there with his tshirt held out and the salmon jumped up over and went in the shirt, and of course he went in too. Because these ledges were slippery. Anyway, he got a bath.
K: Did he manage to hold on to the salmon?

E: Oh no, he could never hold ontop that. They are real fighters. It's such a shame to lose all the tourism dollars. And I'm sure that the amount that power station runs, which they don't always have water, I'm sure there would be more in tourism dollars than we would get off that. We have tidal power – get at that. There could be lots of power from that.

K: They need to explore their options a little more.

E: But anyway, I don't expect you'll ever see that.

K: I was talking to a guy in Lawrencetown, who runs his business out of a house and he said it used to be a hotel, and as soon as the salmon disappeared, the hotel lost business. Because everyone who stayed there came to fish salmon.

E: The Falcourt Inn was a place where people stayed to fish. It was booked all the time with people who wanted to fish. It was a hotel at that time. It may have cost $10 or $15 to stay there for the night.

K: Levi had copied some articles out of the paper, I think it was 1910, or before, that they already realized they needed to do something to save the salmon the salmon in the Nictaux river back then. They recognized this, but never did anything to mitigate.

E: They built these fishways, that to me is something else. When you realize back that far ago that they decided to build these fishways, so somebody recognized something. But like they did with Walter Baker, they shunned them away. But I don't really think there's any use – the spawning ground aren't reachable now anyways. Anyone who put salmon, or salmon fry in are wasting their time. Because the rivers, the streams that have the places where salmon spawn are Waterloo Brook and the Shannon River and places like that…

K: Up that far?

E: Oh yeah. I can remember in the fall, the salmon as you know spawn in the fall, I can remember people saying that the salmon were so thick that you could almost walk across them. They were that thick at Albany, and up that way along the railroad track, you're in sight of the river. And they said there were just thousands of salmon. And now there's nothing.

K: So the salmon went all the way up to Shannon River, Waterloo Brook – were they up further?

E: Oh yes, I'm sure they were. At that time, I don't know. But there was always constant water flowing through there. Granted there were dry summer too. But there were beautiful gravel beds. The gravel beds are still there. Now they try to pacify people by putting in these german brown trout. They put in 80, 000, probably in the late 50s. But all they did was ate the speckled trout.

K: They outcompeted everything. I was talking to someone else who canoes from, maybe the Shannon River, from Squirreltown to, I'm not sure. But he was saying there were all beautiful gravel beds up there.

E: Oh yeah, they're just beautiful. I remember being up there in October hunting, because deer season used to open October 15th, years ago, and when you went up there you could look out there and see all these salmon.

K: Well this is good to hear. Because NSPs claim is that fish never made it up that far anyways, they couldn't, there was a natural barrier.

E: But they did.

Appendix N: Comments From Nova Scotia Fishing Forum – Historic Information

Posted 12 December 2012 – 2:28pm

Perry

I was raised in Lawrencetown and salmon fishing was very popular with the local anglers in the Annapolis River and I spent many hours watching them ply the waters. At the time I was told it was the most prolific river in NS. This is hearsay as what I was told happened when the dam went in on the Nicteaux River. I can remember first hand that every brook feeding into the Annapolis that I fished for trout had salmon fry in them, Finneys, Nursery, Gehues to name a few. When the dam went in a fish ladder was not required and they built a hatchery to collect broodstock and offset the damaged caused by the dam and lack of a fishladder. The offspring of the Nicteaux river broodstock was spread all over to increase runs in other rivers but the Nicteaux went into decline.
The turbine that was installed was too big for the available water and in the spring the river ran full but by summer no water was left to run the turbines and the River went dry so no available fly, parr habiatat = no salmon.
It was suggested a smaller turbine should be installed to spread the slow of water over a longer time and return the river habiatat to allow trout and salmon fly to live there but never happened. You will see this in the summer now same old same old. Could still be done.
There still was salmon angled in Round Hill Brook until the tidal power was installed and that was the end of any amount of salmon. It also distroyed the striper population in the river.
The Annapolis River runs cleaner and still has a healty run of shad and brook trout but because of hydro electricity production this poor river is a shadow of its historic self.
Coles notes of a long story!!

Appendix O: Comments From Nova Scotia Fishing Forum – Fales River

Posted 10 January 2013 – 12:10pm

caper26

A local old guy told me that Salmon used to lay eggs in the Fales River just downstream from the green bridge at Rock notch Rd. I fished that whole river from there to Avery's one year and caught trout only. No salmon of course. Just thought you might like to know that they used to be there... Not sure if the source was reliable or not.

Posted 10 January 2013 – 5:35pm

Perry

Yep it's reliable. I did a stream inventory below the bridge below the waterfall years ago and found salmon parr. Did you notice the drilled hole at the falls with the turbine at the bottom. One of the first hydro electric turbines in the province.

Posted 11 January 2013 – 9:20am

kwagner_fish_habitat_tech

Thanks for the information! How many years ago would you say you saw the salmon parr? Just trying to get an idea of timelines. I've never travelled the Fales River, so I'm not very familiar with it. Are the falls downstream of the bridge towards the Annapolis? Are they a natural barrier to fish passage, or would salmon be able to jump over them?

Posted 11 January 2013 – 9:55am

Perry

The falls is about 100 yds below the bridge and a flyingfish couldn't get over it! I was part of a project that inventoried a number of streams in Kings Co. and the Fales and Mumford fell under the criteria. It seems like a hundred years ago but was when the inland fisheries changed from Nova Scotia Dept Lands and Forest to Nova scotia Dept of Fisheries. All the data was lost in the changeover.

Posted 11 January 10:05am

caper26

I was talking about the rock notch bridge. It was below that one that was the grounds for the eggs. the other bridge upstream.. yeah, I followed the stream up there, and there is a HUGE drop, like 200 feet or something, and he is right. I fish in a helicopter wouldn't get up it.