

Truax Dam Removal Monitoring on the Saugeen River

- 2021 Update Report -

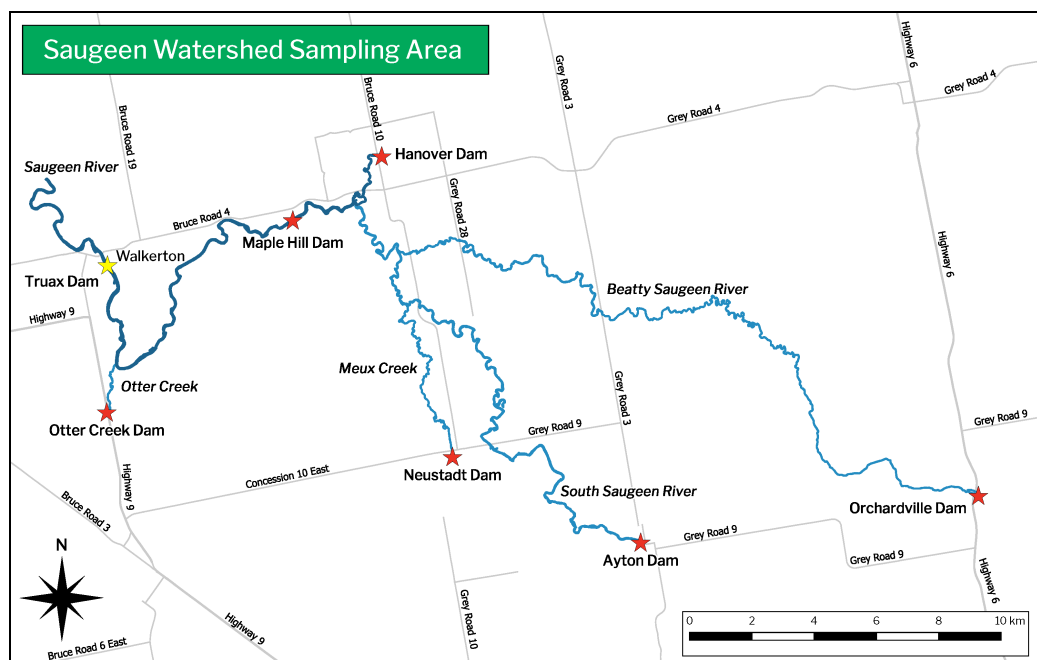
In a partnership between Bruce Power, the Lake Huron Fishing Club and the Municipality of Brockton, and with expert direction from GSS Engineering Consultants Ltd., the century-old Truax Dam in the town of Walkerton, ON was successfully removed in 2019, thereby reducing safety concerns with the ageing structure and eliminating a major barrier to fish passage in the Saugeen River (Figure 1). Scientists from Bruce Power and Biotactic Inc. teamed up with support from Golder Associates to design a Before-After-Control-Impact study to monitor the effects of the Truax Dam removal and to quantify the environmental benefits to the Saugeen River fishery. The monitoring performed includes electrofishing surveys to measure changes in fish biomass and production, habitat assessments, redd surveys to monitor changes in fish spawning, and underwater video and radiotelemetry studies to track fish passage and movement.

Twenty-two sampling locations were established throughout the Saugeen River watershed (Figure 2), and two years of baseline data were collected in 2018 & 2019 before the dam was removed in August 2019. Post-dam removal monitoring began fall 2019 and is currently on-going. Several more years of monitoring are planned so that the long-term benefits of the dam removal can be quantified. Already, opening up the Saugeen River at Walkerton has provided fish greater access to high-quality habitat upstream and increased spawning within monitored tributaries. In addition, natural riffle-pool habitat river morphology has re-established within the former dam headpond, providing additional spawning habitat and increasing fish community diversity and biomass within the area. A high-level summary of these data is shown in the following pages.



Figure 1 – Aerial images of the Truax Dam footprint, Walkerton, ON before and after removal. The original wooden dam was built in 1852 and later replaced by the concrete structure shown above in 1919. While the dam had a fishway that allowed the passage of some migrating salmonids under specific flow conditions, it posed a significant barrier to fish passage for more than a century before it was removed in the summer of 2019, restoring river connectivity.

Figure 2 – Twenty-two long-term monitoring sites are located in the Saugeen (upstream & downstream of the former Truax Dam) and within the South Saugeen & Beatty Saugeen Rivers and Otter and Meux Creeks. Dams (red stars) are natural end-points of the study area as fish cannot pass upstream of these structures. Control sites with independent fish communities are located outside of the study area, upstream of the Hanover and Otter Creek dams.



Radiotelemetry – tracking the movement of Rainbow Trout throughout the Saugeen River watershed

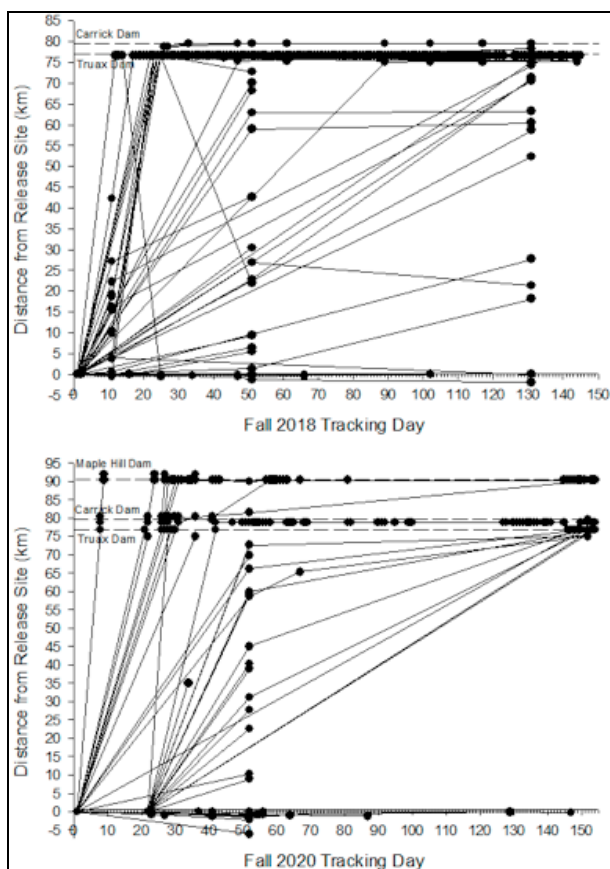


Figure 3 – Comparison of the movement of fish tagged fall 2018 tracked from Oct 15, 2018 to March 7, 2019 (top; 144 days) and fish tagged fall 2020 tracked from Oct 17, 2020 to March 19, 2021 (bottom; 154 days). Denny's Dam (release site) is river km 0 with Truax, Carrick and Maple Hill dams 76.79km, 79.54km and 90.34km upstream, respectively. Prior to removal of the Truax Dam in 2019 the majority of fish were blocked downstream for long periods, but now they are able to pass.

Telemetry is an innovative way to track migration patterns of fish. Using implanted transmitters and a series of receivers that pick up unique signals, individual fish can be precisely geo-located and behaviours can be analyzed. Biotactic Inc. specializes in performing these types of fish tracking studies and partnered with Bruce Power to better understand Rainbow Trout movement in the Saugeen River watershed as they migrate inland from Lake Huron each spring and fall, as well as the potential impacts of the removal of the Truax Dam on this movement. With the help of volunteers from the Ontario Steelheaders and the Lake Huron Fishing Club, 300 fish have been radio-tagged to-date (including spring 2021; data not yet available). Fish are tracked using fixed (stationary) receivers placed near Denny's, Truax, Carrick and Maple Hill dams as well as by mobile methods (airplane, automobile and by foot).

Radiotelemetry has revealed unprecedented information on the timing, seasonality and degree of passage and delay of fish attempting to pass the Truax Dam and other upstream structures (Table 1). Tracking data after the removal of the Truax Dam have shown that fish are now able to more easily pass the former dam footprint, and they do so more quickly and without using up as much of their energy reserves as before (Figure 3). Post-dam removal passage at the Truax footprint has increased by an average of 140% in the spring and by 462% in the fall. Delay at the footprint has decreased by an average of 59 hours in the spring and by 191 hours in the fall. Removal of the Truax Dam has also translated into greater passage at dams further upstream (Table 1; Figure 3) and the greater use of high-quality spawning habitats within the upstream tributaries. While no fish were able to pass Carrick and Maple Hill Dams in the fall pre-removal of the Truax Dam, 63% of arriving fish were able to pass Carrick Dam and 50% of the arriving fish were able to pass the Maple Hill Dam for the first time in fall 2020. Passage at these upstream dams in the spring also increased by an average of 103% (Carrick) and by 131% (Maple Hill) post-Truax Dam removal.

Table 1 – Radiotelemetry results collected in the spring & fall of 2018–2020. Fifty adult Rainbow Trout were captured and implanted with radio-transmitters by Biotactic Inc. at Denny's Dam on Apr 22 & Oct 15-16, 2018, Apr 26 & Oct 28, 2019 and Oct 17 & Nov 7, 2020. No fish were tagged in spring 2020 due to COVID-19 restrictions. "New" are fish newly tagged that season, "Prev." refers to fish tagged in a previous season that are still able to be tracked.

Monitoring period		S'18		F'18		S'19		F'19		S'20		F'20	
Fish tracking group		New	Prev.	New	Prev.	New	Prev.	New	Prev.	New	Prev.	New	Prev.
Sample size (n)	(# fish tagged or remaining)	50	49	50	96	50	128	50	165	0	122	50	122
	(# relocated)	43	14	43	54	44	25	46	45	-	15	42	42
Denny's Dam	(# not migrating upstream)	10	6	4	9	12	15	21	8	-	8	11	11
	(# arrived at Truax)	27	1	17	31	28	1	10	30	-	1	18	18
Truax Dam	(# passed upstream)	17	0	3	22	17	1	7	27	-	0	16	16
	(% passage)	63	0	18	71	61	100	70	90	-	0	89	89
Carrick Dam	(average delay, hrs)	23	-	193	186	31	1	5	7	-	-	2	2
	(# arrived at Carrick)	17	-	2	22	17	1	7	31	-	-	16	16
Maple Hill Dam	(# passed upstream)	14	-	0	17	17	0	0	27	-	-	10	10
	(% passage)	82	-	0	77	100	0	0	87	-	-	63	63
Tributaries	(# arrived at Maple Hill)	13	-	-	13	12	-	-	22	-	-	8	8
	(# passed upstream)	5	-	-	12	8	-	-	17	-	-	4	4
Harvested	(#)	1	-	3	1	4	-	-	77	-	-	50	50
	(#)	1	-	3	1	4	-	-	77	-	-	50	50
Abbreviations: S–spring; F–fall; T–Teeswater River; OC–Otter Creek; BS–Beatty Saugeen River; MC–Meux Creek.													

Fish Biomass – measuring changes in fish production

Using well-established multi-pass electrofishing methods, Bruce Power and Biotactic Inc. are collecting key information about all fish species inhabiting the study area (Figure 2). Fish are collected each summer at 22 sampling locations and identified to the lowest taxon possible. Each one has its length and weight recorded and is then returned safely to the river after it is taxonomically identified. This information is used to calculate the total fish biomass present in the fish community. Changes in fish productivity from year to year will be used to assess the impact of the Truax Dam removal on the Saugeen River watershed. The net gain in fish biomass is being credited to Bruce Power as an Offset within its *Fisheries Act* Authorization.

Following removal of the Truax Dam, sites located upstream within the former dam headpond quickly re-established natural river riffle-pool flow sequences and decreased in water width, depth and increased in flow (Figure 4). Fish communities within these sites also showed an immediate response to the dam removal. Fish community diversity and biomass (g/m²) increased, with juvenile Rainbow Trout found within the newly formed habitats within just one year of dam removal (Table 3). While less change was measured at other upstream sites, juvenile Chinook Salmon were also identified for the first time upstream within the Saugeen River, found at sites located downstream of both Carrick and Maple Hill Dams. Sites downstream of the Truax Dam footprint changed comparatively little in either environmental conditions or fish community characteristics post-removal, relative to the measured amount of yearly variation naturally occurring within the river (Figure 4; Table 2).

Moving forward, sites throughout the study area, including those further upstream within the Saugeen River and within upstream tributaries, are expected to also see an increase in fish community abundance and biomass. Radiotelemetry, redd and videography study results all indicate that a greater number of Salmonids are able to spawn within the higher-quality habitats upstream of the Truax Dam footprint. The degree to which this reproduction will translate into greater fish biomass throughout the watershed will continue to be quantified during the on-going long-term summer monitoring.

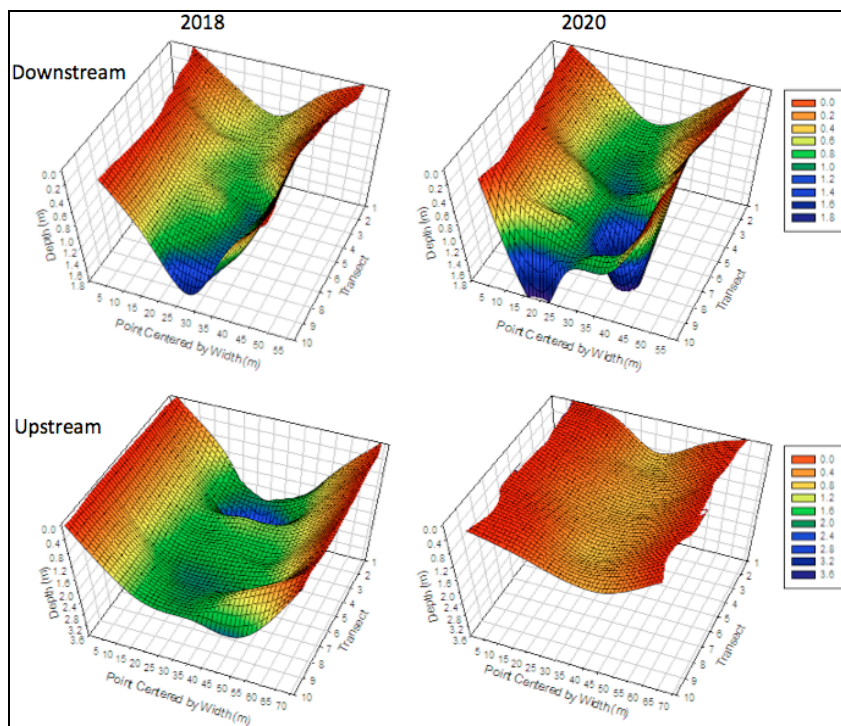


Figure 4 – Habitat assessments were done at each site to characterize the type and quality of fish habitat present and to link that information to the presence and abundance of fish inhabiting the area. Assessments at locations near the former Truax Dam are on-going to document changes in habitat that have occurred from the dam removal. Shown here are three-dimensional profiles of sites located immediately downstream (top row) and upstream (bottom row) of the Truax Dam footprint from assessments conducted in 2018 pre-removal (left column) and in 2020 post-removal (right column).

Family	Species	PRE 2018	PRE 2019	POST 2020	Family	Species	PRE 2018	PRE 2019	POST 2020
Catostomidae	Northern Hog Sucker				Catostomidae	Northern Hog Sucker			
	White Sucker					Redhorse Sp			
						White Sucker			
Centrarchidae	Largemouth Bass				Centrarchidae	Rock Bass			
	Rock Bass					Smallmouth Bass			
	Smallmouth Bass								
Cyprinidae	Blacknose Dace				Cyprinidae	Blacknose Dace			
	Blacknose Shiner					Blacknose Shiner			
	Bluntnose Minnow					Bluntnose Minnow			
	Central Stoneroller					Central Stoneroller			
	Common Shiner					Common Shiner			
	Creek Chub					Creek Chub			
	Finescale Dace					Hornyhead Chub			
	Hornyhead Chub					Longnose Dace			
	Longnose Dace					River Chub			
	River Chub					Rosyface Shiner			
	Rosyface Shiner					Spottail Shiner			
	Spottail Shiner								
	Unidentified								
	Sp.								
Ictaluridae	Stoneroller				Percidae	Blackside Darter			
						Fantail Darter			
Percidae	Blackside Darter					Iowa Darter			
	Fantail Darter					Johnny Darter			
	Iowa Darter					Rainbow Darter			
	Johnny Darter				Salmonidae	Rainbow Trout			
	Rainbow Darter								
Petromyzontidae	N. Brook Lamprey								
Salmonidae	Rainbow Trout								
Total # of fish		464	291	301	Total # of fish		235	55	212
Average Biomass		1.67	2.40	2.20	Average Biomass		1.61	0.59	12.46

Tables 2 & 3 – Summary of fish community diversity and productivity results from baseline (2018 & 2019) and post-dam removal (2020) monitoring. Left and above show information for a site immediately downstream and upstream of the Truax Dam footprint, respectively.

Underwater Video & Spawning Surveys

Underwater solar-powered motion-activated infrared cameras were installed to monitor fish movement, activity and health at key times in the spring and fall at Otter Creek and the Maple Hill Dam. To-date the number of unique fish identified at these locations has increased by 156% in the fall at Otter Creek and by 492% in the fall and 234% in the spring at Maple Hill Dam, after removal of the Truax Dam (Figure 5). Surveys to quantify the number of spawning Salmonids are also being conducted each spring and fall, targeting Rainbow Trout and Chinook Salmon, respectively. Surveys are performed by both Bruce Power and Biotactic Inc. scientists at locations in Otter Creek, Meux Creek and the Beatty Saugeen River, and post-Truax Dam removal within newly created spawning habitat in the Saugeen River. To-date within just the Saugeen River and Otter Creek the number of Rainbow Trout redds has increased by an average of 233% and Chinook Salmon redds by an average of 188% after the removal of the Truax Dam (Figure 7). Combined with detailed movement data from radiotelemetry and quantitative measurements of fish biomass and production from electrofishing surveys, long-term monitoring is providing a comprehensive picture and understanding of the impacts of the Truax Dam removal and the benefits of this removal on the Saugeen River fishery.

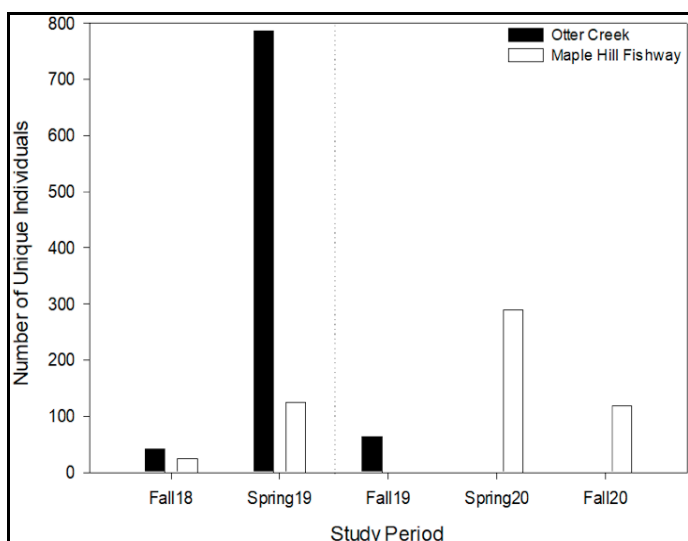


Figure 5 – Results from videographic surveys conducted in Otter Creek and at Maple Hill Dam during baseline (Fall 2018 & Spring 2019) and post-dam removal (Fall 2019 - Fall 2020) monitoring (left and right of dotted line). Number of unique individuals is the number of fish counted within transcribed video recordings.

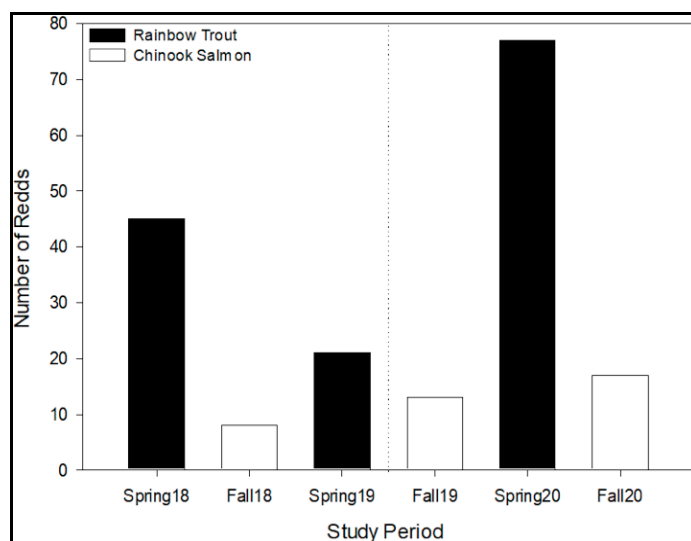


Figure 6 – Results from spawning surveys conducted in the Saugeen River and Otter Creek during baseline (Spring 2018 - Spring 2019) and post-dam removal (Fall 2019 - Fall 2020) monitoring (left and right of dotted line). Number of redds is the combined total counted in the two locations across each season.



Figure 8 – An adult radio-tagged Rainbow Trout with visible white floy tag moving upstream past the Otter Creek camera on May 9, 2019 (left); Two Rainbow Trout smolts moving downstream through the exit of the Maple Hill Dam fishway on May 21, 2021 (right).