# Niagara River Watershed Fish Community Assessment (1997 to 2011)

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Ontario

- Anne  R. Yagi, Niagara Area Management Biologist - Ontario Ministry of Natural Resources, 4890 Victoria Ave. N., Vineland Station. Ontario, P.O. Box 5000, L0R 2E0, email: anne.yagi@ontario.ca
- Catharine Blott Contract Fisheries Crew Leader- Ontario Ministry of Natural Resources, 4890 Victoria Ave. N., Vineland Station. Ontario, P.O. Box 5000, L0R 2E0

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*Cover Photograph is Gord Ives (MNR-LEU) holding a muskellunge and was taken by Anne Yagi during spring 2008 on the Welland River between the Canals section. Photograph below (left to right) David Denyes, Katharine Yagi, Rob Tervo and Amy Brant back pack electrofishing on Drapers Creek by Anne Yagi.*

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# EXECUTIVE SUMMARY

The Canadian portion of the Niagara River watershed including the river and its tributaries comprises 1,338.54 km$^2$ watershed area and includes 65 smaller subwatersheds or catchments the largest of which is the Welland River. From 1997 to 2011, both tributaries and mainstem stations were fish sampled using standard methods (electrofishing boat (EB) or backpack (BP), or seine (S)) totalling 480 sampling sites (180EB, 122BP, 178S). An additional 31 regional sites were sampled by EB for comparative purposes. The purpose of this project was to describe resident (June to Oct) fish communities (fish species and relative abundances) in relation to indicators of habitat quality, ecosystem quality and overall biologic diversity.

The Upper Niagara River tributaries function as spawning and rearing habitat for many species, with adults residing in the Niagara River during summer. The Welland River and its tributaries provide the same function for Niagara River species but canal syphons remain partial barriers. Periodic large migratory runs of species such as emerald shiner, spottail shiner and gizzard shad are evident in the Upper Niagara tributaries, and into the lower reaches of the Welland River, but canal syphons (particularly the upstream siphons at the Old Welland Canal) filter the majority of these from accessing upstream reaches of the Welland River. Similarly, evidence of spawning by species of the sucker family for example are evident in Upper Niagara tributaries, but are absent or diminished in the Welland River above the canal syphons. Approximately 880 km$^2$ or 65% of the Niagara River watershed is upstream of these syphons.

Binbrook Reservoir and the Welland River West continue to show low variation in species diversity and abundance as compared to unimpeded tributaries of the Upper Niagara River and other control sites. The stocking of walleye in 1997 successfully established them in the fish community in certain sites in the Welland River West and “Between the Canals”. There have also been anecdotal reports by local fisherman of walleye in the Welland River East near Port Robinson. The areas walleye inhabit correspond to higher water quality sites during summer low flow season. Walleye are absent in the fish community downstream of Oswego Creek to Coyle Creek in the Welland River in the summer low flow season. Their summer distribution is a good measure of poorer water quality and the need for habitat and flow improvements in this river section.

A review of historic information and regional reference sites were also completed for comparative purposes. Based on this assembly of information important remedial actions and suggested fish community monitoring are proposed. The most significant of these are:

- INVESITGATE AN ECOLOGICAL APPROACH TO THE PRESENT OPERATIONAL CONTROLS OF SUMMER DAILY WATER LEVELS
- INCORPORTATE AN ECOLOGICAL APPROACH TO BETTER UTILIZE WATER FLOW CONTROLS AT 3 LOCATIONS; TRIANGLE ISLAND (CONFLUENCE OF WELLAND RIVER AND NIAGAR RIVER FLOWS), OLD CANAL AND BINBROOK RESERVOIR
- MITIGATE CONNECTIVITY CONTROLLERS AT TRIANGLE ISLAND AND OLD CANAL SYPHONS
- COMPLETE INSTREAM HABITAT RESTORATION IN THE UPPER NIAGARA RIVER, WELLAND RIVER EAST AND PORT ROBINSON CHANNEL, WELLAND RIVER WEST.
- COMPLETE SPECIFIC TRIBUTARY RESTORATION PLANS
- MANAGE SPECIES INTRODUCTIONS TO ASSESS LIMITING FACTORS (CONNECTIVITY, WATER QUALITY, SPAWNING HABITAT)
- MONITORING- TO ASSESS EFFECTIVENESS OF RESTORATION PROJECTS (RADIO TELEMETRY, MARK RECAPTURE, ABUNDANCE AND DIVERSITY, SPRING SURVEYS)

# 1 INTRODUCTION

The Niagara River watershed is naturally and anthropogentically complex, setting the stage for a diverse fish community assemblage. Natural differences in the fish community are related to the Niagara Falls cascade feature, current flow, velocity, substrate, cover, aquatic plants, channel depth, presence of groundwater discharge flow and precipitation. Anthropogenic influences on the fish community are related to the alteration of flow regimes for hydro-electric production, shipping canal construction, water flow diversions, drainage of wetlands, channelization of streams, nutrient enrichment, introduction of exotic species, and presence of contaminants or pollutants (industrial, municipal, agricultural). In 1987, the International Joint Commission designated the Niagara River watershed as an area of concern (AOC). As a result, the Niagara River Remedial Action Plan (RAP) was created, pinpointing issues concerning the health of the river system and recommending actions to improve the use of the river for humans, fish and wildlife communities. The RAP recognized an impairment of fish consumption, fish populations, fish migration and fish habitat, and designated the entire watershed as part of the area of Concern (AOC) which included the Welland River subwatershed (NRRAP 1993; NRRAP 1995).

From 1997 to 2011 the Ontario Ministry of Natural Resources conducted fish community surveys throughout the Niagara River watershed using standard methods and effort (seining, boat and backpack electrofishing). The purpose of this study was to characterize the fish community within the Niagara River and its tributaries. Sampling was largely conducted during the summer to fall resident season, but when possible included some spring collections. Prior to this study the fisheries of the watershed had been only sporadically sampled.

Data is presented on subwatershed basis within the context of Aquatic Resource Areas that are defined by anthropogenic-derived distinctions. The data is discussed in terms of species distribution and abundance to show 1) how accessible tributaries are, 2) how the tributaries are functioning to provide spawning and rearing habitat for the larger river species, 3) how water quality and/or habitat is reflected in community assemblages, and 4) whether trophic structure of fisheries communities reflects fisheries management goals.

Fisheries management goals for the Niagara River watershed are to:

1. maximize habitat availability and use of the river system by fish communities that will transfer nutrients into long-lived desirable species (sportfish and other native aquatic and terrestrial piscivores), and
2. maintain or re-establish connections and habitat to support as much of the bioregional fisheries community and distribution as possible (includes but not limited to Species-at-Risk).

# 2 NIAGARA RIVER WATERSHED & ANTHROPOGENIC INFLUENCES

## 2.1 NATURAL SETTING

The Niagara River is an interconnecting channel, or isthmus, linking the two Great Lakes Erie and Ontario. The river contains a major cascade (Niagara Falls) located approximately in the middle of the channel with an abrupt elevation drop of 51 m (167 ft) (Niagara Parks Commission, 2005). The falls separates the Niagara River into two distinct Aquatic Resource Areas (ARA) known as the Lower and Upper Niagara Rivers. Fisheries of the Lower Niagara River are an extension of the Lake Ontario community, whereas fisheries of the Upper Niagara River are part of the Lake Erie community. The Niagara River itself is estimated to be 58 km long. The vast majority of water flow is from the Upper Great Lakes watershed and only a minor portion attributed from adjacent lands. The Canadian portion of the watershed area is 1,338.54 km2, comprised of the Welland River watershed and several small Upper Niagara River tributaries (NPCA-GIS, 2008). Flow alterations related to the Welland Canal result in areas in the Welland River which are nearly severed from the watershed collection system, looking like a pinch point in the watershed boundary (Figure1). The area above the western pinch point represents ~880km2 or about 64% of the upper Niagara River watershed (NPCA-GIS, 2008).

**Figure 1 Niagara River Watershed (Canadian portion)- satellite image courtesy of Google Earth©**

The Welland River is the largest Canadian tributary of the Niagara River watershed, draining an area approximately 1023 km$^2$ (Phillips Engineering Ltd., 2003). The Welland River originates in the Hamilton area and flows in an easterly direction through the Haldimand Clay plain physiographic region to the Niagara River. Soils in the watershed are primarily clay, clay loam, sand and sandy loam with occasional gravel seams (Chapman and Putman, 1984). The Welland River is approximately 135 km long with an overall 82 m elevation change (0.61m/km). The first 55 km of the western portion has the highest gradient (1.42m/km), followed by a very low gradient section with a 4 m elevation change for the last 80 km (0.05m/km).

The majority of water flow in tributaries is from precipitation events sustained by seasonal groundwater table discharges. A minor portion of flow is attributed to discharges from deeper groundwater aquifers (Fonthill Kame Moraine, Willoughby Marsh). Only 5 of 32 Welland River tributaries have permanent flow in summer. In most tributaries upper reaches dry down leaving residual pools that play an important role in maintaining fish habitat through the summer and winter low flow seasons. The Binbrook dam impounds any groundwater as well as spring storm-derived water from the headwaters area and was designed to augment summer flow in the main stem of the Welland River (Dillon 1965); however this management practice has lapsed in recent years (sections 2.2.3 and 4.8).

Years with greater amounts of precipitation result in more available habitat in low flow seasons. During the study period all years were above the 42-year average precipitation except 2007 when there was an extreme low precipitation total, similar to 1971 and 1998 (Figure 2 and 3). Figure 4 isolates precipitation records for the summer sampling months June to October. This period is generally a low precipitation time period with August having the least precipitation (Figure 4). However, in wetter years like 2005 and 2009 the pattern does not show a decrease through the summer months. Although preciption influences catch results, the fish community sampling period occurred during both dry and wetter seasons allowing the results to capture the natural seasonal and annual variation in the watershed (Figure 4).

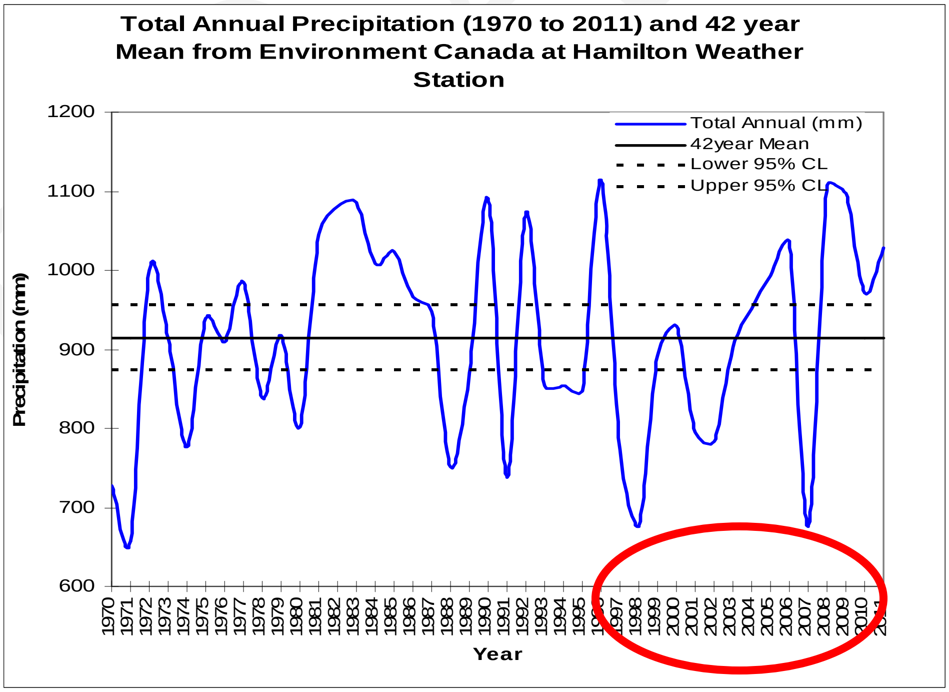

**Figure 2 Total Annual Precipitation 1970 to 2011**

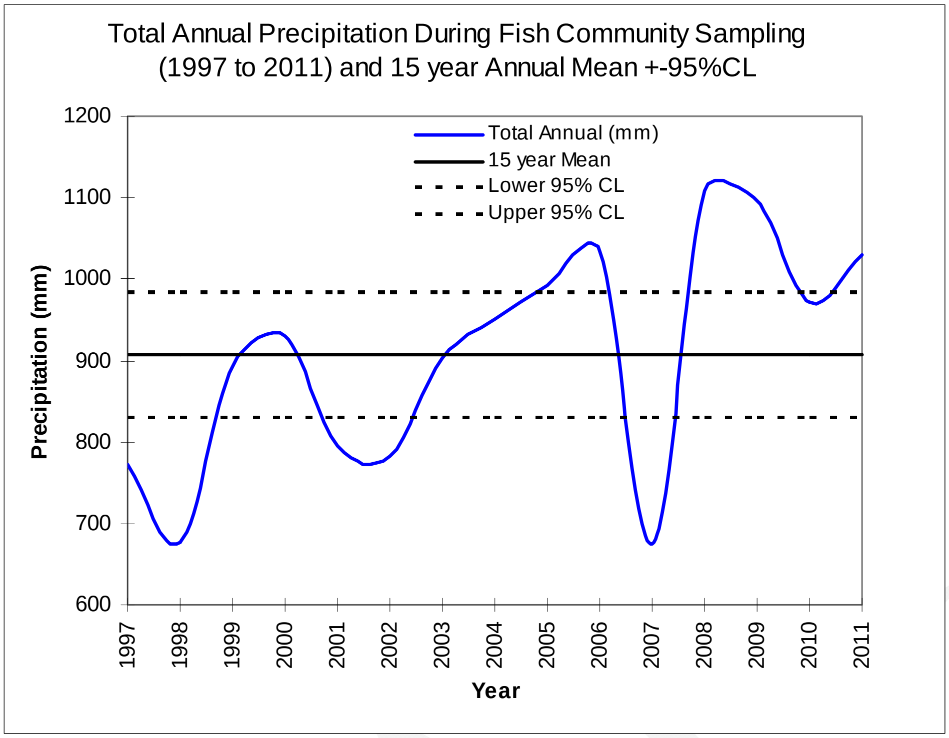

**Figure 3 Total Annual Precipitation during study period 1997 to 2011**

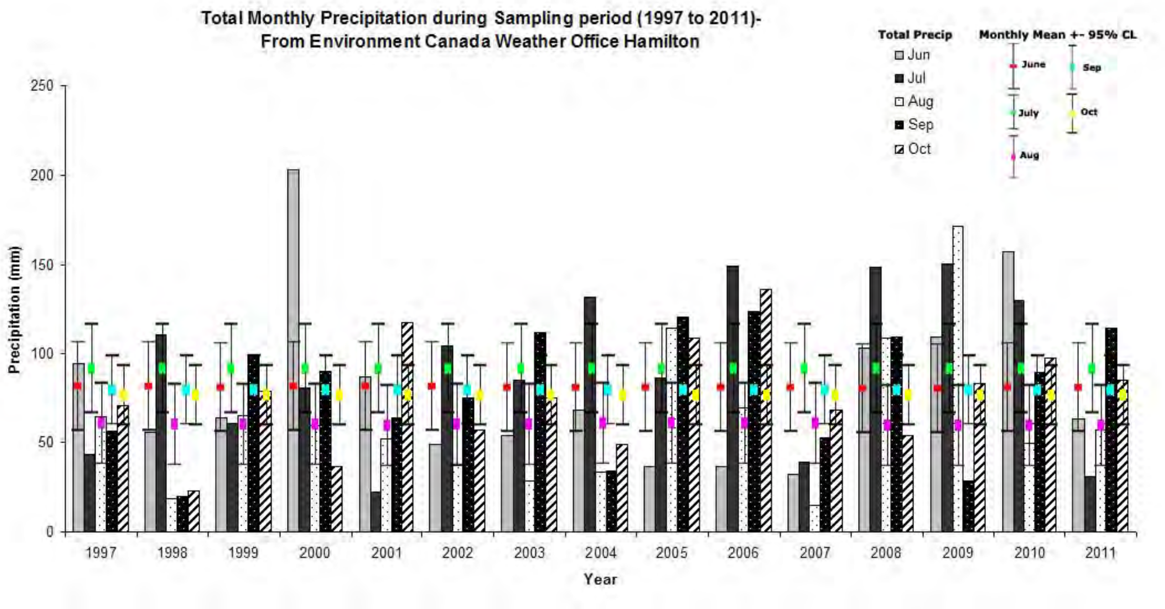

**Figure 4 Monthly Precipitation for All Sample Years with monthly means +-95%CL for same 15 year time period**

## 2.2 ALTERED NIAGARA RIVER WATERSHED & ESTABLISHEMENT OF AQUATIC RESOURCE AREA (ARA'S)

Several anthropogenic changes were made to the physical character of the Niagara River watershed for hydro electric production, Great Lakes shipping and water management control. An understanding of the natural and altered environment explains the rationale behind further sectioning of the Niagara River watershed into more detailed Aquatic Resource Areas.

### 2.2.1 Hydroelectric Development

Historically the Welland River entered the Upper Niagara River in an estuary about 1.5 km above Niagara Falls in the town of Chippawa. In 1953, the last 7 km of the Welland River was widened and channelized to accommodate Niagara River flows toward the Queenston-Chippawa Power Canal (Phillips Engineering Ltd., 1999), reversing flow in this last 7km. Since 1953 the Welland River flow meets the Niagara River flow 7km upstream of the original Welland River mouth at the head of the Power Canal. This 7km stretch is known as the Chippawa Channel and is considered a separate ARA. In 1973, an international water control structure located on the Upper Niagara River, Grassy Island Pool (GIP), began regulating the diversion of water flow into the Chippawa Channel and over Niagara falls by maintaining water levels within a specific elevation range (170.71m – 171.51m GSC). This was completed under the authority of the International Joint Commission (IJC). During the summer tourist season flow is further regulated to ensure tourist attraction water flow over the falls during the day and water diversion at night. The flow regulation amounts to a summer daily 0.6m vertical fluctuation in water levels. The vertical fluctuation extends horizontally out from the shoreline of the main river and upstream into every tributary that enters the river within the GIP controlled elevation range (Figure 5). In the Welland River daily fluctuation extends 60 km upstream (westward) to Port Davidson (Dillon 1965; Phillips Engineering Ltd. 1999, Yagi, 1994) and in low flow periods (summer and winter) the fluctuation causes flow in the lower reaches of the Welland River to be reversed due to the very shallow gradient of the river. This part of the Welland is also the section of river with poorest summer water quality (NPCA, 2010) and the section targeted for low flow augmentation from Binbrook reservoir by Dillon (1965).

Additionally as part of hydroelectric production manipulations, an ice boom is installed annually every fall at the mouth of the Niagara River between Fort Erie and Buffalo and is removed in May. The ice boom acts to reduce ice flows in the river which contribute to clogging of water intake tunnels impacting hydroelectric production. Thermal flux differences between the river and tributaries have recently been studied which may contribute to periodic fish kills in Upper Niagara tributaries (MNR unpublished data).

**Figure 5 Spatial extent of the Hydro electric Water Level Control Structure (Grassy Island Pool) influence on Welland River main stem (extent in red)**

## 2.2.2 Welland Shipping Canal Development

Each of five shipping canals physically altered a portion of the Lower Welland River from upstream of the City of Welland to the Town of Chippawa (original Welland River mouth). The river was channelized, diverted and moved. Most recently, during construction of the City of Welland bypass canal in 1973, flow was diverted from the Fourth Welland canal into the Welland River to maintain the quality of the water supply for the City of Welland and to dilute waste water discharges.

### The Early Welland Canals

The Lower Welland River from Port Robinson to Chippawa formed part of the first Welland Canal from 1824 to 1833 (Figure 6). Modifications to the river began as early as 1820's when a new straight easterly outlet channel to the Niagara River was created at Chippawa (Sytran and Taylor, 1992) (Figure 7). The early canals were challenged by the lower water elevation in the Welland River compared to the water level in the canal. To deal with this difference in elevation the early version of the canal crossed the Welland River using an aqueduct to convey ships over the river and the river was allowed to run freely underneath (Figure 8).

### The Fourth Welland Canal

When the fourth canal was constructed in 1932 the aquaduct was removed and the river was diverted into six "U shaped" tubes and conveyed under the canal. These tubes were 6.7m in diameter and 13.1 m deep (Dillon, 1965; Yagi, 1994; Yagi, 1997; Phillips Engineering Ltd, 2001) (Figures 9 and 10). It is the fourth canal siphons that remain a significant fish migration barrier and will be discussed in Section 2.5.1. Within this report the 4th Welland Canal is also referred to as the Old Welland Canal.

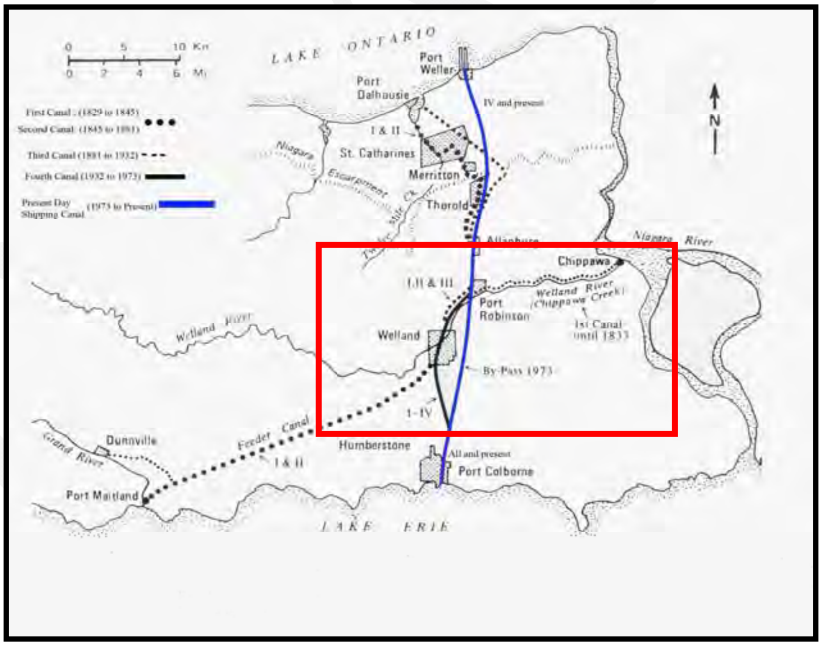

**Figure 6 Historic and Present day Welland Shipping Canal Locations (Modified from Sytran and Taylor, 1992). The red rectangle area is where most physical changes to the Welland River occurred since European settlement and is enlarged and detailed in Figure 11.**

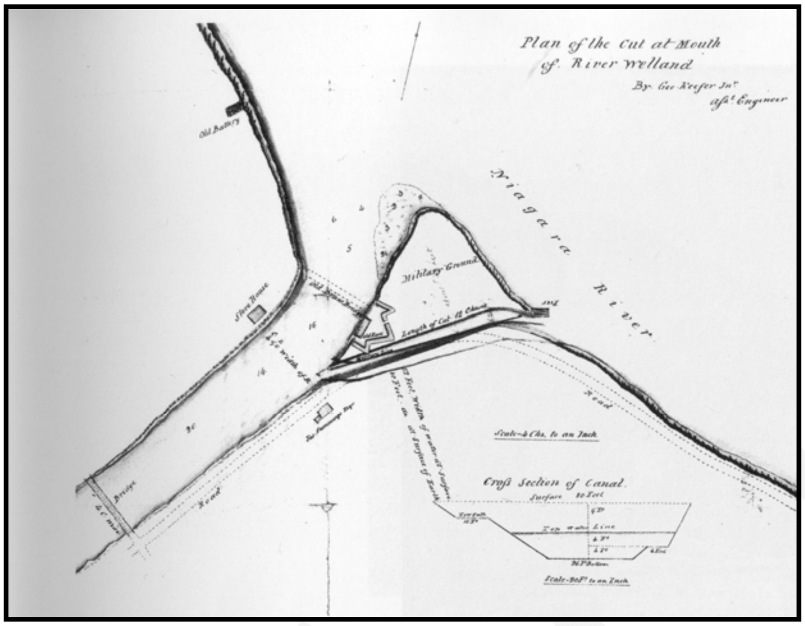

**Figure 7 Plan of the First Welland Shipping Canal Cut through the Estuary at the mouth of the Niagara River in Chippawa circa 1820's (Styran and Taylor, 1992)**

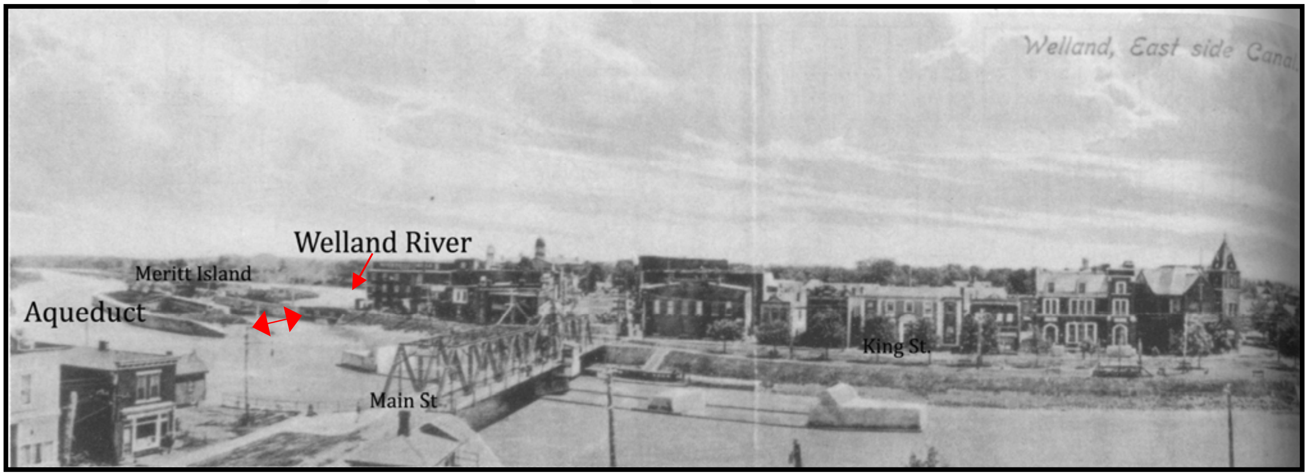

**Figure 8 City of Welland (looking east) in 1910 showing modern named streets and the location of the aqueduct feature during the Third Canal Operation near Merritt Island just north of Main St Bridge (Modified from Styran and Taylor, 1992).**

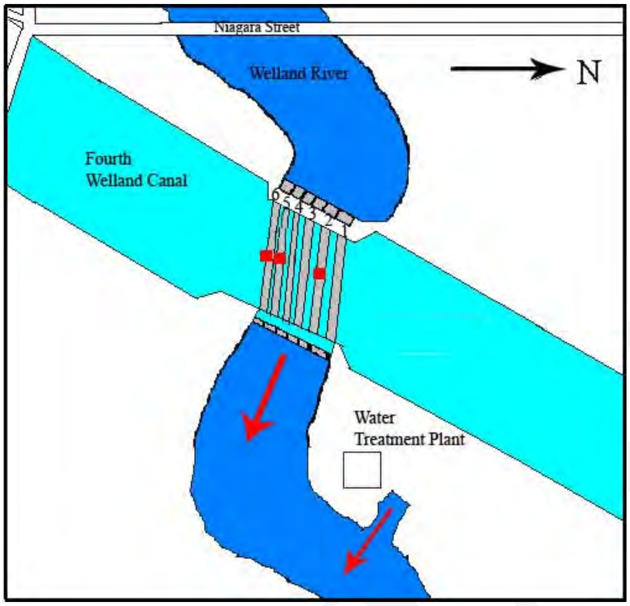

**Figure 9 Top View of Fourth Welland Canal Syphon Structure and the Welland River City of Welland. Six grey cylinders are the bottom of the "U shaped" tubes that connect the Welland River upstream and downstream of the Canal (1932). Red dots indicate the tubes that were plugged for the experiment (2000).**

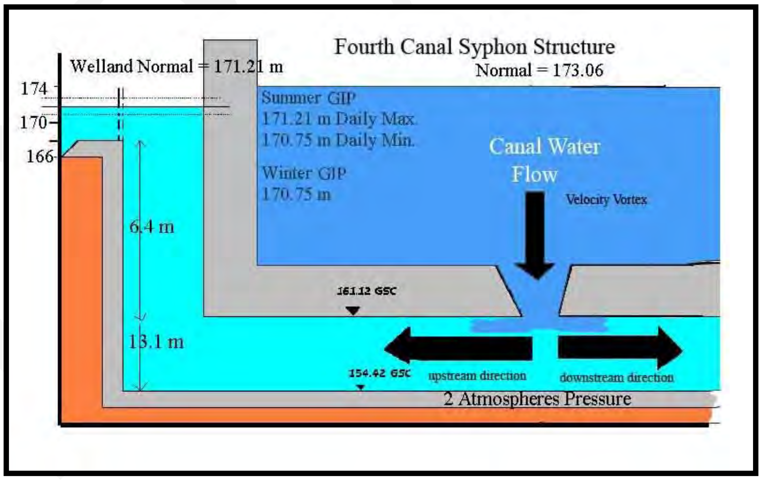

**Figure 10 Cross section of one half of a "U-shaped tube" showing the connection from the bottom of the Welland Canal to the river. Holes to all tubes were added in 1973. The water level elevations are indicated in the diagram.**

## The Modern Welland Canal By-Pass

When the City of Welland Bypass Canal was constructed in 1973 a series of new physical changes were made to the river (Figure 9).

A. A new syphon structure in Port Robinson was made to divert the Welland River under the new Shipping channel. This was different in design to the Fourth Canal syphon structure and consisted of three trapezoidal shaped tubes.
B. The Welland River was realigned and channelized to accommodate the new siphon structure and canal.
C. A portion of the Port Robinson channel was left in its natural state and flow was added from the Shipping Canal to maintain water quality and fish habitat in this river bed section.
D. A new channel was constructed on the east side of the new canal in Port Robinson.
E. The Fourth Welland Canal was partially filled in south of the City of Welland to create a transportation corridor with tunnels under the new canal. This caused the fourth canal in the City of Welland to become stagnant.
F. One hole (1 meter diameter) was cut from the bottom of the canal into each of the 6 “U shaped tubes” to increase flow and improve water quality within the fourth canal. This made a water connection from the Canal to the river. The amount of water flow was not controlled but dependent upon the size of the hole. Water flowed into the river from the canal continuously thereafter. Three of these holes were plugged in 2000 as part of a fish movement experiment (Biotactic, 2000). These holes remain plugged (Figure 10) and (Figure 11)
G. The feeder canal was diverted to the Welland River upstream of the fourth canal making a permanent connection with the Grand River Fish Community in the 1970’s.

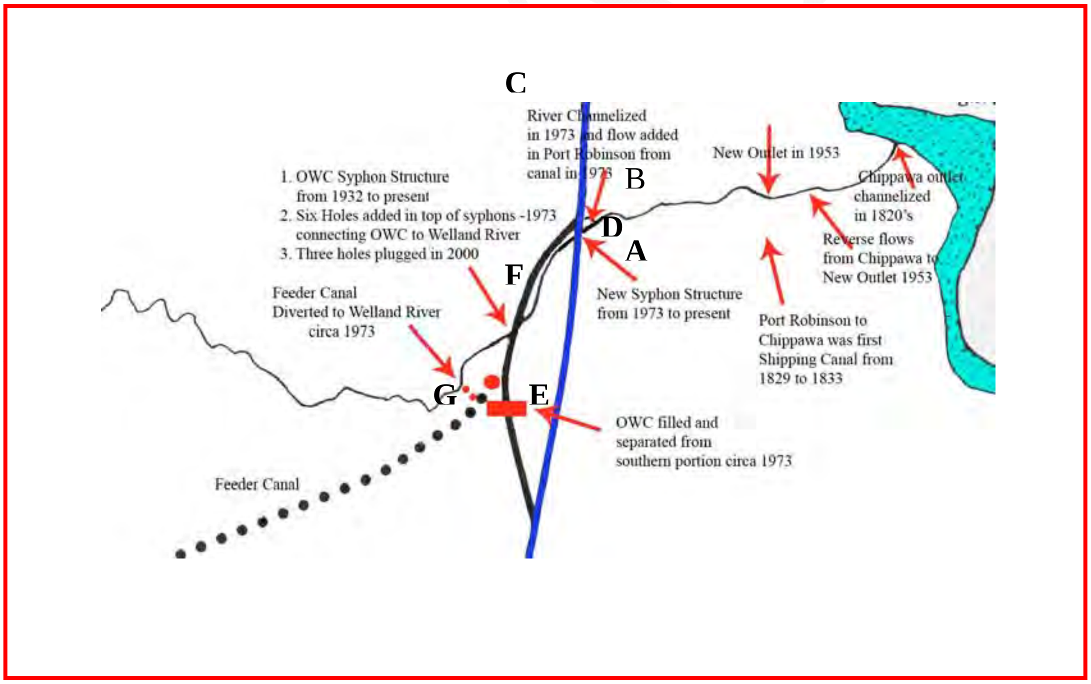

**Figure 11 Detailed Descriptions of Physical Changes to Lower Welland River post European Settlement**

### 2.2.3 Other Water Control Structures

In addition to hydroelectric and shipping changes, the Binbrook Reservoir, Canborough Weir and Port Davidson Weir were constructed in the 1970’s to help manage water levels and water quality in the Welland River west of the City of Welland. The Binbrook Reservoir was engineered to capture flow from the upper watershed in spring and gradually realease water through the low flow season. Flow augmentation was necessary to mitigate poor water quality conditions causing fish kills in the river. The reservoir was designed to augment base flow at a rate of 16 c.f.s for 200 days (Dillon, 1965). By 1978 the management outline of the reservoir included goals to develop recreational opportunities “while maintaining the water management benefits which have been realized since the construction of the Binbrook Dam and Reservoir” (NPCA, 1978). Since that time, management goals have shifted to prioritize the reservoir as a recreation and wildlife area over and above its original intended use of flow augmentation to the river. Now, a minimum water level is maintained in the reservoir for recreation activities, and discharge from the reservoir during low flow period is set at just 5 c.f.s. This amount is released only as long as target water level in the reservoir is maintained. The new targets compromise low flow augmentation to the river and associated benefits of improved water quality and base flow. The discharge rate is reduced to less than one third of the original design flow, and in drier years the rate is further reduced to maintain target water level in the reservoir. In 2007, a below average dry year, there was zero discharge from the reservoir in the low flow period from July through October (NPCA, 2007).

The Canborough and Port Davidson Weirs were constructed to hold water for fire protection, farm use and aesthetics. Additionally the weir at Port Davidson acts as the upstream endpoint of the zone of influence from the GIP water level fluctuation. Modifications to the construction of each of these structures have occurred to allow or enhance upstream fish migration. At the Port Davidson weir coarse substrate has been added to increase that type of spawning habitat in the Welland River. These structures are discussed further in the fish sampling results.

### 2.2.4 Niagara River Watershed - Aquatic Resource Areas

Due to natural and anthropogenic derived diversity of the watershed, 11 Aquatic Resource Areas (ARA) have been identified (MNR NRVIS). They are; Upper and Lower Niagara River, Upper Niagara River tributaries, Chippawa Channel, Chippawa-Queenston Power Canal, Welland River East, Welland River Between-the-canals, Welland River West, Welland River Above Port Davidson, Binbrook Reservoir and Welland River Headwaters (Figure 12).

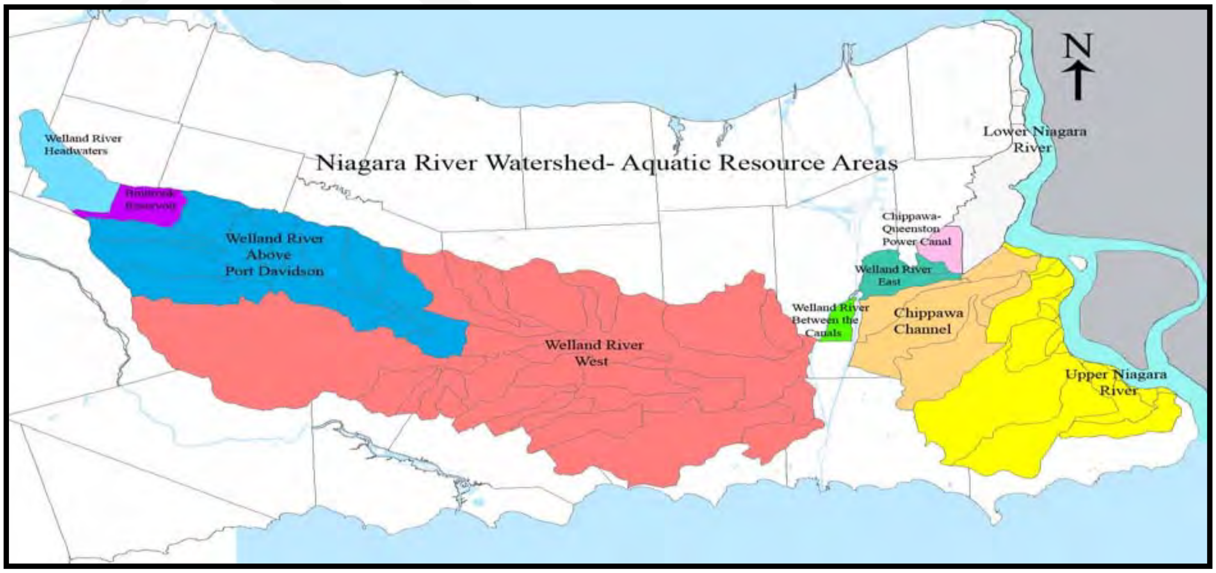

**Figure 12 Niagara River Watershed- Aquatic Resource Areas**

## 2.3 IMPLICATIONS OF ANTHROPOGENIC INFLUENCES ON AQUATIC HABITAT IN THE WATERSHED

### 2.3.1 Water Level Fluctuation

The Niagara River shoreline has been significantly altered from its pre settlement condition. Along the Upper Niagara River, few shoreline wetlands and natural riparian areas exist. The estuary in Chippawa has disappeared and the vast majority of shoreline has been treated with rock or concrete for erosion protection. This shoreline treatment together with a narrow band of woody vegetation in a “park like” setting continues for almost its entire length and extends upstream into each of seven key tributary estuary areas. The Lower Niagara River has no tributaries with direct fish habitat but the flow regime and parts of the shoreline for this section of the river have also been altered to reflect changes made by hydro electric diversions since the early 19th century. The effects of fluctuating water levels in the Upper Niagara watershed include repeated exposure and inundation of the littoral zone both laterally and longitudinally along each water course within the influence of the GIP control structure. Littoral zones are shallow areas between land and water and are often used as spawning and nursery fish habitat. Fluctuating water levels beyond natural seasonal cycles causes excessive bank erosion, channel widening and result in the absence of riparian vegetation. The effect is reduced the further away from the GIP control structure. For example, each Upper Niagara River tributary now has rock rip rap erosion protection lining their outlets with bedrock close to or at the surface. Wetland vegetation is absent at the tributary/river interface but is located upstream from the tributary outlet area beyond the zone of influence (Figure 13). The loss of wetland habitat at the tributary mouths creates a biological disconnect between the Niagara River and the tributaries.

**Figure 13 A) Baker Creek Outlet to the Niagara River is protected by rock rip rap and has no aquatic vegetation growth. B) Baker Creek just upstream of Niagara Parkway Bridge with Aquatic vegetation**

Evidence of the anthropogenic control of natural water level cycles can be seen throughout the watershed within the influence of the GIP control structure depending upon the time of day and location. Unlike the smaller tributary mouths of the Niagara River, where rip rap controls further erosion, in most of the effected area the erosion is left unchecked. In summer, along the Welland River shoreline at night, mud flats are visible, and in the daytime they are once again submerged. The constant ‘washing’ of the bare shore from the daily inundating and draining of the banks erodes materials into the receiving water system increasing the sediment loading to the system. This erosion, and resultant turbidity, coupled with exposed mudflats along the shoreline every day during the growing season limits submerged aquatic plant growth and emergent riparian growth (i.e. cattails, burreeds, arrowheads etc). Few plant species can withstand the poor light penetration along with the continual cycle of inundation and drying of their root systems, as well as exposure to freezing when fluctuations occur in winter. Loss of aquatic plants and the riparian growth means the rooted vegetation zone that helped to maintain the historic width to depth ratio in the river is no longer there to function in that capacity. The river has gradually become wider over time. When water levels are lowered more than usual for maintenance activities on the GIP structure the former riparian shelf is visible (Yagi and Attema, pers. obsv. mid 1990's). Visually, the river reach and tributaries affected by the fluctuating water levels have an active channel much wider than expected, the banks are vertically eroded and there is often an abrupt transition from the the active channel to upland vegetation with little to no transition through a wetland riparian zone (Figures 14).

**Figure 14 Upland trees and grasses growing along water edge in Welland River West spring 2008 (left) and eroded edge of river visible in Welland River Between-the-Canals fall 2007 (right). Ecological vegetation gradients typically found along low gradient rivers**

At times the combined effect of GIP structure water level fluctuations and the introduced flow at the Old Canal Syphons overwhelms natural downstream flow in the lower Welland River. This occurrence depends on time of day, season, and how much water is being diverted from the Niagara River. The worst scenario occurs in the low flow seasons, when the daily flow regime of the river swings from sluggish downstream flow to no flow (ponded conditions) to a sluggish *upstream* flow. There are many ecological consequences for the river system. The water in Welland River West (west of the old canal syphons) is more turbid than it would be under normal riverine flow conditions. Suspended solids in the water column are held upstream during reverse flow. Additionally, clear water introduced from the bottom of the canal flows upstream when water levels reverse (summer and winter) creating clear water conditions close to the syphon structure which gradually become more turbid in a westerly direction. This is a reverse turbidity gradient compared to natural rivers and can influence fish community distribution and possibly homing cues. While the canal water adds 'fresh' cooler water for a 2km distance upstream, improving water quality, the preference would be to have the canal flow introduced further upstream in the river to help flush the system, provide flow cues for fish movement and lessen the backwater/upstream flow influence of the GIP control structure.

The effect of water level fluctuations is also evident in the Niagara River itself, especially the Lower Niagara River. The sudden increase or drop in water levels can be quite dramatic and known to interrupt shoreline spawning activities (A.Yagi Obsv.) of such as species as trout, sturgeon and suckers.

Today there are limited shoreline areas within the water level control zone that have a natural vegetation transition from upland to wetland habitat. The desired shoreline vegetation gradients primarily exist in low gradient watercourses outside of the water level control influence such as Lyons Creek east (Figure 15). Opportunities are identified in the recommendations of this report where instream habitat works can re-establish areas of shoreline riparian habitat. Some species such as willow shrub and dogwood grow well under these conditions provided they have some initial protection until they get established. In addition some herbaceous aquatic plants thrive under fluctuating conditions and grow in floating mats such as American Water-willow[1]. These species should be the focus of shoreline restoration activities.

**Figure 15 Demonstrating Vegetation Gradients for low gradient water courses found in the AOC upstream of water level control. This is Lyons Creek East.**

### 2.3.2 Low Flow Augmentation

While the Niagara River receives flow constantly from Lake Erie, much of the rest of the watershed is primarily precipitation driven with only a handful of groundwater fed tributaries. The Welland River in particular is subject to extreme dry down periods with permanent flow limited to 5 small spring-fed tributaries and 2 tributaries with flow augmentation from the Welland Canal. Anecdotal springs in the Welland River above Port Davidson and in the Welland River headwaters are unconfirmed, but several local farmers in this area recall that the Welland River used to flow all year (Blott, pers comm., 2007). The Binbrook reservoir, originally constructed to augment flows to the Welland River during the low flow seasons, has diversified from its original purpose and now includes recreation and flood control objectives such that low flow augmentation is severely limited or halted altogether (NPCA, 2007). The original design discharge of 16 c.f.s. likely resulted in continuous flow through the dry season in the Welland River above Port Davidson.

Continuous low flow in the Welland River West would maintain fish habitat quality, allow for continuous sediment and nutrient transport, help ameliorate the affect of reverse flows, daily water level flux and provide an ecologically dynamic littoral area for emergent plant growth. In 2007, which was a very dry year and zero flow augmentation from the Binbrook Reservoir left only pool habitat in a portion of the Welland River above Port Davidson. Ongoing monitoring of flows in the Welland River downstream of the reservoir is recommended to determine a suitable operational regime that focuses on improving the water quality of the Welland River West.

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[1] Any project involving American water-willow (SAR) will require ESA approval

**Implications of Anthropogenic Influences on the Fish Community**

Since 1953 the Welland River has been treated as a reservoir or water storage area for hydroelectric production and therefore behaves more like a tidal estuary/lake than a river during the low flow seasons (summer and winter). In addition, habitat impacts from controlled water levels, flow reversals and channel diversions disrupt natural cues (thermotactic, rheotactic, homing) that many fish depend upon to complete their annual life cycle (Yagi et al, 1994; Yagi 1998).

A 1930's assessment describes the Welland River as having an "abundant fish forage base and rich wetland riparian zones, slightly turbid river, excellent conditions for walleye stocking". The biologist noted captures of abundant cyprinids and blue walleye just west of the City of Welland (Cairn, 1932). The present day lack of emergent marsh edge and lack of a well developed riparian area has severely altered the fish communities associated with the historic shoreline floodplain and aquatic vegetation. Fish data presented in this report reflects this alteration. Nutrient assimilation functions associated with vegetated shoreline habitat are minimized because most water flow bypasses limited shoreline vegetation, remaining in the water column available to be tied up into algal bloom cycles.

### 2.3.3 Fish Spawning Migration

A specific objective of the Niagara Remedial Action Plan is identified as "A watershed in which all fish species can freely migrate from the Niagara River to all tributary headwater areas" (NPCA, 2000). Many Niagara River species form a spawning migration from a larger waterbody into tributaries where they congregate in suitable areas and broadcast their gametes over specific habitat. For spring spawners this spawning migration coincides with spring freshet flows, increasing daylight hours and specific water temperatures. Once an individual spawns they are no longer in a migratory behavioural condition and they move back toward the larger waterbody. There are limited historic studies or assessments to verify the cumulative effects of the aforementioned anthropogenic changes to the migrating species community over time. One theory put forth by the author to consider is the following;

> *In the 1820's when the Welland River outlet in Chippawa was first channelized, fish migrants most likely successfully adapted to this challenge. However, once the river was diverted through 6 vertical "U shaped" tubes in the City of Welland in 1932, fish migration from Lake Erie-Upper Niagara River system was likely significantly challenged upstream of the City of Welland (refer to back to Figure 8, Section 2.2.2, for detailed drawings of these modifications). In 1953, when the Welland River outlet changed to the Power Canal location, flow (rheotactic), thermal (thermotactic) cues and even natal homing cues between the Upper Niagara / Lake Erie fish community and the Welland River were impaired and the Welland River fish community became more isolated from the larger diverse fish community over time. With the addition of holes in the syphons in 1973, which connected the canal bottom to the syphon structure, fish migration would be unlikely (A. Yagi, 2000).*

To test this theory, a fish migration telemetry study was proposed by MNR and NPCA. The white sucker was chosen for this experiment because they are a common spring spawning migratory species in the Great Lakes region and are tolerant of turbidity.

Three syphon holes were plugged by the City of Welland: tube # 6 nearest the shoreline, #5 and #2 (Figure 16). Plugging these holes eliminated the water flow and turbulance created by the linkage with the canal in these three tubes and recreated the original 1932 design condition. The other tubes remained the same as the 1973 design. Since spawning locations in the Welland River were not known (Yagi, 1998), MNR staff transported 15 live white suckers (in spawning condition) from the Grand River to the Welland River on April 11, 2001. Fish were handed over to the consultant, tagged with external radio transmitters and released 100m downstream of the 1932 syphon structure. Two stationary receivers were in place upstream and downstream of the syphon structure with an antennae on each entrance (upstream and downstream) for a total of 12 antennae. Receivers automatically scanned for each transmitter code for 6s in every 36 seconds (one sixth of the time) and were in place for 30 days. This means 2400 scans were taken each day at each of the outlets and inlets of each of the six syphons for a total of 28,000 6-second scans per day. In addition a limited mobile search was conducted upstream and downstream of the syphon structure on April 14th and from a canoe on May13th.

Five individual fish were found downstream of the syphons within a few hours of the original release on April 11th, but not found in this area on April 14th during the mobile survey. Instead fish were located downstream of flow discharging from the water treatment plant downstream of the syphons. No other observations in the vicinity of the syphons were documented until two weeks later when a receiver detected 1 fish upstream of tube #6 (representing the 1932 treatment without the introduction of canal water). The fish then swam through tube # 6 when flows reversed that same day.

Where did the other 14 fish end up? It is unlikely they moved through the structure and were not detected given the exhaustive transmitter scanning. Since the fish were in spawning condition at the time of the release and radio tagged fish were found 3 days later in the vicinity of the Water Treatment Plant outflow where spawning substrate is present, it is highly possible white sucker spawning activity was taking place in this area within a few days of their release, and was completed well before a fish presence was detected upstream of the syphon on April 30th. However, without having spent any time actively verifying their daily location, movements through the structure remain unknown. The study concluded that the Old Welland Canal syphon structure was not a complete barrier to fish migration (Biotactic Inc., 2001). This is a very strong statement to make with only one confirmed use of the syphon in 30 days and no controls in place to differentiate spawning migration behaviour from a random event. One way to control for determining migration behaviour is to release half the radio tagged sample upstream of the structure and half below, and spend considerably more effort in a mobile telemetry study locating the tagged fish every day.

The question of whether the Old Welland Canal syphon structure is a fish migration barrier remains unanswered at this time because specific studies have not been conducted. **However, if a structure delays a spawning migration or filters out or prevents the majority of individuals in a population from reaching spawning grounds, it remains a migration barrier.** Sampling presented for this study indicates several species' distributions extend up the Welland River to just downstream of the 4th Canal syphons (spottail shiners and suckers). It is therefore highly likely that fish migration west of the City of Welland has been impaired since 1973 and to some degree since 1932. Additional spring migration surveys (Mark /Recapture) and intensive short term spring mobile fish radio telemetry studies (March and April) are warranted upstream and downstream of these suspected fish migration barriers.

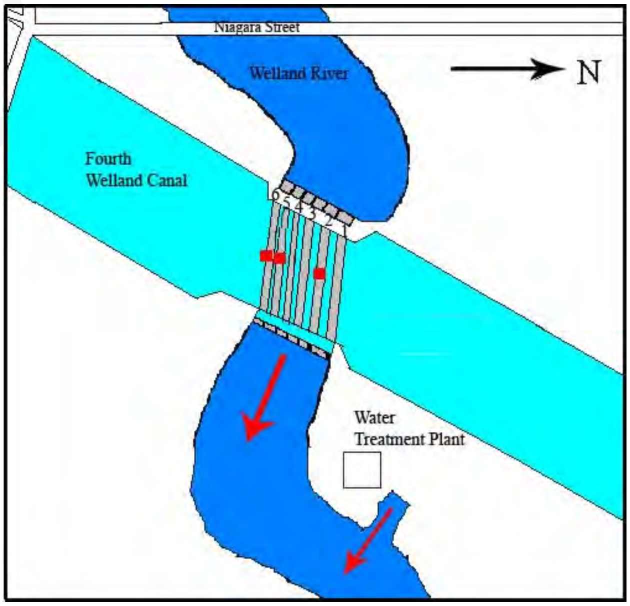
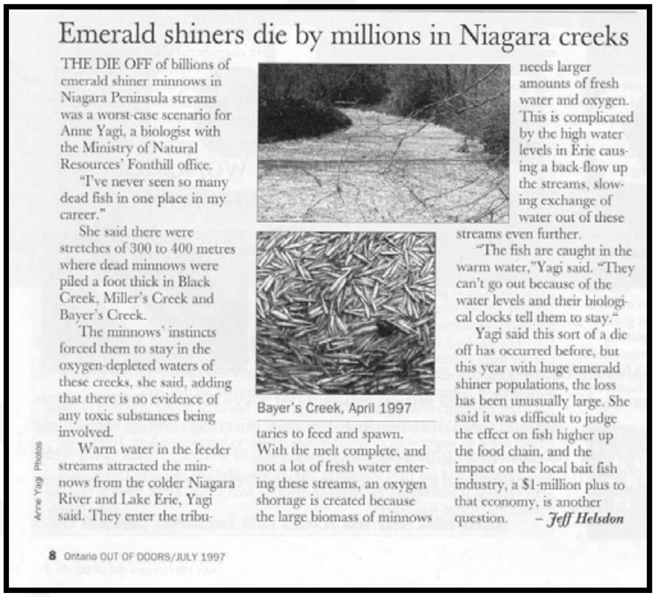


**Figure 16 Aerial view of the Old Welland Canal siphons on the Welland River. Six grey cylinders are the bottoms of the "U shaped" tubes that connect the Welland River upstream and downstream of the Canal. Red dots indicate tubes that were plugged for the white sucker experiment (2000).**

### 2.3.4 Emerald Shiner Spring Migration - Upper Niagara River Tributaries

An emerald shiner spring migration into the tributaries of the Upper Niagara River is an annual event. Commercial bait harvest of these tributaries coincides with this migration event. Past studies using fry traps could not verify that this species spawned in these tributaries (Tilt et al, 1977). In spring 1997 a significant die off of emerald shiners occurred in several Upper Niagara River tributaries and extreme temperature differences were suspected (Figure 17). Therefore a spring thermal study was initiated to compare water temperatures along the river shoreline and within three tributaries: Boyers Creek, Usshers Creek and Black Creek. Six Hobo Onset© real time temperature data loggers were deployed each spring from 1998 to 2000 (MNR and MOE unpublished data; Yagi, In Prep). **Preliminary results confirmed that Upper Niagara River tributaries are significantly warmer than the Upper Niagara Shoreline water temperatures** (Figure 18). In addition the temperature flux between Boyers Creek and the Niagara River was significantly less than the temperature flux between Usshers Creek and Niagara River and between Black Creek and the Niagara River (**Error! Reference source not found.**). This may be related to watershed size differences because Boyer's Creek is the smallest and overland tributary flow may be less than the other creeks sampled. There also may be more backwater effect from the Niagara River lowering temperatures in the Boyer's Creek compared to the other two tributaries.



Emerald shiners die by millions in Niagara creeks

THE DIE OFF of billions of emerald shiner minnows in Niagara Peninsula streams was a worst-case scenario for Anne Yagi, a biologist with the Ministry of Natural Resources' Fonthill office.

"I've never seen so many dead fish in one place in my career."

She said there were stretches of 300 to 400 metres where dead minnows were piled a foot thick in Black Creek, Miller's Creek and Bayer's Creek.

The minnows' instincts forced them to stay in the oxygen-depleted waters of these creeks, she said, adding that there is no evidence of any toxic substances being involved.

Warm water in the feeder streams attracted the minnows from the colder Niagara River and Lake Erie, Yagi said. They enter the tributaries to feed and spawn. With the melt complete, and not a lot of fresh water entering these streams, an oxygen shortage is created because the large biomass of minnows needs larger amounts of fresh water and oxygen. This is complicated by the high water levels in Erie causing a back-flow up the streams, slowing exchange of water out of these streams even further.

"The fish are caught in the warm water," Yagi said. "They can't go out because of the water levels and their biological clocks tell them to stay."

Yagi said this sort of a die off has occurred before, but this year with huge emerald shiner populations, the loss has been unusually large. She said it was difficult to judge the effect on fish higher up the food chain, and the impact on the local bait fish industry, a $1-million plus to that economy, is another question. – *Jeff Helsdon*

Bayer's Creek, April 1997

Anne Yagi Photos

8 Ontario OUT OF DOORS/JULY 1997

**Figure 17 Emerald Shiner die off article (Ontario OUT OF DOORS / July 1997)**

This study provided additional supportive evidence that the emerald shiner run is related to a thermal cue response. The Niagara River water temperatures are colder longer in the early spring which entices the emerald shiner to converge into the smaller tributaries which offer a warmer alternative habitat. Since their populations cycle and can be quite abundant some years, their sheer numbers ascending these small tributaries creates a huge demand on available oxygen and they can die off similar to the 1997 spring event. As an update, another large emerald shiner die off occurred in spring 2012 following a warmer than normal winter. We are unsure at this time what role the management of the hydro electric ice boom has on these temperature differences. No spring time studies have been completed regarding fish movements and timing of ice flows, however the thermal differences provide an indication of why these minnows are attracted to these tributaries and how they could potentially become death traps. If the ice boom held ice back later it would allow the river to warm up then the release of ice in the river would cause a sudden drop in temperature making the tributaries more thermally preferable to the river.

In the 1997 fisheries study, abundant emerald shiners were detected downstream of the OWC syphon structure and 7 individuals found upstream in the Welland River West near Port Davidson. Abundant shiners were also detected in several regional reference sites Martindale Pond (summer) and Lake Gibson (fall). If the emerald shiners respond to warmer spring thermal cues they should also migrate in large numbers into the Welland River upstream of the City of Welland and be well represented in that community. Surveys done in this recent study period (2003 – 2009) have captured some of the migrations of emerald shiner and other species, which demonstrate filtering by the canal syphons, but specific spring and fall electrofishing surveys would help to add clarity to the degree to which the canal syphons are affecting fisheries, and to how many species.

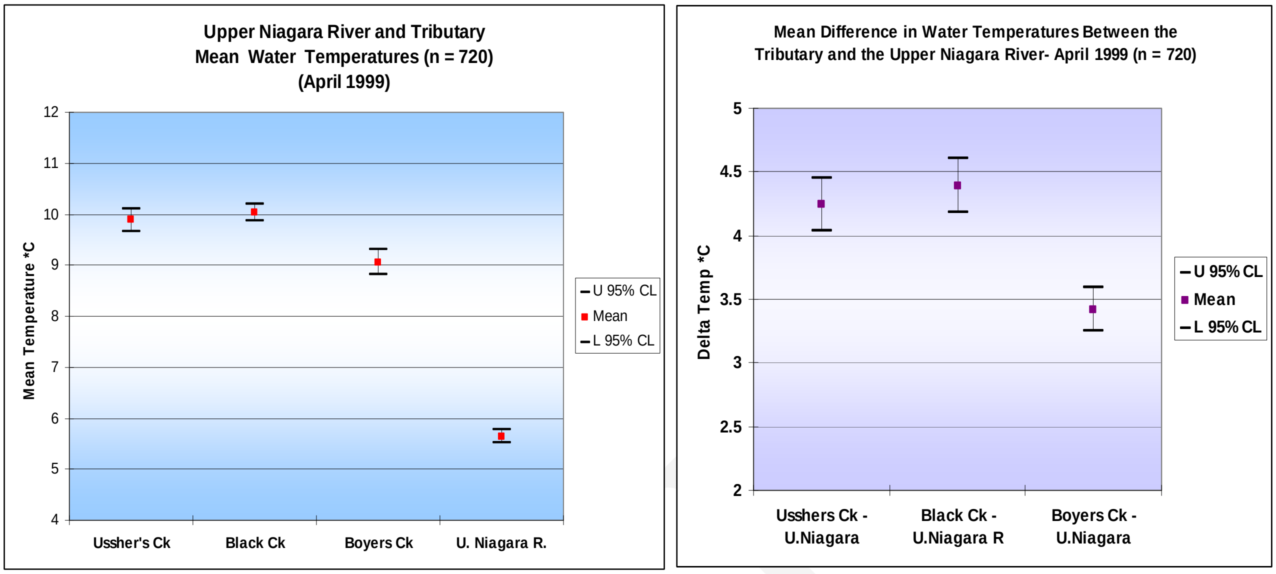


**Figure 18 A) Comparison between the Upper Niagara River Shoreline Spring Water temperatures and Tributaries in April 1999. B) Compares the Thermal Difference (Flux) between Each Tributary temperature and the shoreline temperatures of the Upper Niagara R.**

## 2.4 PREVIOUS FISH STUDIES- NIAGARA RIVER WATERSHED

In the Niagara River watershed, fish populations have been described as being impaired, with degraded fish populations and habitat (NR RAP, 1993). Due to the highly treacherous river flow conditions and the presence of Niagara Falls, most habitats in the river are difficult to sample. Many biologists attempted to collect pertinent data over the years however most historic data is from singular point in time sampling spread out over several decades using various techniques and levels of effort. Therefore, trend through time data is not readily available. The recent inclusion of boat electrofishing has provided a more consistent, safe, reliable and repeatable sampling effort throughout the watershed.

### 2.4.1 Lower Niagara River

There are no small tributaries entering the Lower Niagara River that are inhabited or used by fish. Most of our historic fish community information comes from commercial fish harvest records, sporadic trap netting in eddies for sport fish contaminant monitoring, creel census surveys and trawling near the mouth of the river at the Niagara Bar. Young-of-the-Year (YOY) muskellunge surveys and sturgeon sampling have also been conducted by the New York Department of Environmental Consevation, (NYDEC).

### 2.4.2 Upper Niagara River

Upper Niagara River tributaries were inventoried in 1974 and standard biomass studies were completed in 1979 (MNR files). Tributary baitfish studies were completed in 1977 (Buckingham et al, 1977) and an emerald shiner harvest study (Sarvis et al, 1985). Several Creel Surveys were completed in the 1980’s and occasional gill netting attempts were made for sport fish contaminant analysis. In late 1990’s, NYDEC in cooperation with MNR completed several YOY muskellunge surveys of *Vallisneria* sp. dominated weed beds in Canadian waters using boat electrofishing (Wilkenson, pers. com.). In 1999 the first shoreline electrofishing boat surveys were completed by the Lake Erie Unit (MNR unpublished data.).

### 2.4.3 Welland River

Recent searches of Ontario archive records revealed the earliest fish sampling record in July, 1932 upstream of the City of Welland. The report described an “abundant fish forage base and rich wetland riparian zones, slightly turbid river, excellent conditions for walleye stocking”. The biologist noted captures of abundant cyprinids and blue walleye just west of the City of Welland. He also noted severe pollution downstream through the City of Welland (Cairn, 1932; Yagi, 1997). Recommendations from that report were to stock walleye. From 1938 to 1960 largemouth bass fingerlings and eyed walleye eggs were stocked annually west of Welland. During the winter of 1961-62 a significant fish kill occurred which apparently killed off all walleye and bass. The recommendations of this study were not to restock bass or walleye again until water quality and benthos conditions improved (Department of Energy and Resources Management, 1965). In the 1970’s and 80’s occasional trap net sets were conducted for sport fish contaminant monitoring. Very little creel information is available. In 1996, some trap netting and minnow trapping and tributary back pack electrofishing was completed. In 1997, the first electrofishing boat survey was conducted in the main river channel as well as some regional reference sites (Yagi, 1997). In July 1997, the Upper Welland River was once again stocked with walleye fingerlings as part of a Community Fisheries Involvement project with Port Colborne, Fort Erie and Dunnville Conservation Clubs (Yagi, 2006).

Several habitat enhancement projects have been initiated in the watershed since the 1997 fisheries study. They are fish passage modifications at Port Davidson Weir in the winter of 2002 (Figure 19), Canborough Weir (Fall 2002), dam removal on Coyle Creek at Pelham Hills Golf Course (Winter 2005), culvert and creek realignment in Lower Drapers Creek at Endicott Terrace (Winter 2006) and channel naturalization projects on Coyle and Drapers creeks (Niagara Restoration Council). Some fisheries assessment work has been initiated to document fish community changes (Biotactic Inc. 2003; Yagi et al, 2006; Hatch Mott MacDonald, 2007).

**Figure 19 A) Port Davidson Weir May 2001 Pre Improvement Project B) Five years After the Improvement Project: longer riffle approach added with rock projection (arrow) to focus attraction flow C) Five Years After: close up showing surface flow channel (red arrow)**

# 3 METHODS

## 3.1 BOAT ELECTROFISHING

The dynamic physical nature of the Niagara River imposes limits to standardized fish community sampling. Therefore sampling locations in the larger waterbodies do not include all available habitats and therefore do not reflect the entire fish community. A Smith-Root, SR-20 electrofish boat with dual anodes provided an opportunity to sample large water body shoreline zones using the same gear and power effort. The ARAs sampled by this method include the Welland River East, Welland River Between-the-Canals, Welland River West, Chippawa Channel, Binbrook Reservoir, Lower and Upper Niagara River shorelines and regional shoreline reference sites. Standard sample sites are restricted to nearshore littoral areas, weed beds and creek mouths within 2-3m depth and/or 0.5 to 3m offshore where electrofishing gear is effective.

All operations were carried out using standard OMNR electrofishing policy. Two persons stood at the bow of the boat and netted immobilized fish.  The same two people were used through out the area surveyed. A third person emptied the netted fish into the on-board live well. A fourth person, the Crew leader, directed the operations to ensure a consistent effort between stations and years.  All immobilized fish had to be netted before the catch was counted. All carp (other than those collected for contaminant monitoring) were tapped with the net end to simulate capture, counted, but not lifted on board. This was to relieve unnecessary strain on the netters. Effort was standardized in terms of electric output or power and time (1000 electrofishing seconds). The duty cycle adjusted to keep the power output of the electro fishing boat at approximately 11 watts. Fish catchability is assumed to be equal for each immobilized fish, however fast water currents, extensive weed areas and high fish abundances wreak havoc with that assumption.  It was the responsibility of the Crew Leader to note these problems during the sampling period. Most electrofishing boat surveys are conducted at night because large fish are more active near the surface.  However, safety concerns with sampling either the Lower or Upper Niagara Rivers prohibited night time sampling. In addition, since many areas sampled had high turbidity, night time fishing would not likely increase our fish capture success, therefore day time sampling was used. One night of electrofishing was attempted on Binbrook reservoir, Welland River Between-the-Canals and Chippawa Channel however boat lighting was inconsistent and that technique was abandoned.

Sites were selected to represent the diversity of shoreline habitats within the littoral zone.  In the Welland River, 50% of the 1997 stations were re-surveyed for trend through time. Sampling near Port Davidson weir was hampered by a large wood debris dam across the railway bridge. We returned in 2005 with a small 10 ft electrofishing boat to search that area for walleye. New sites were selected based on proximity to habitat projects, searches for walleye concentrations and to fill spatial gaps of information. In addition 10% of the previously sampled stations were randomly selected for annual sampling to determine variation between years.

## 3.2 TRIBUTARY SAMPLING

All tributaries are accessible in the watershed; however there are challenges to standardized effort because some substrates are suitably stable for back pack electrofishing while others are too soft and require seining. Sites were seined to replicate the historic sample method for a station and when substrate conditions were too unstable for safe electrofishing. Some areas were not accessible by electrofishing boat, seine or back pack and could not be sampled. Introductory letters describing the purpose of the survey were delivered to landowners of potential sites.  Landowner permission was obtained when private land access was needed. Most landowners were very receptive and quite interested in the project. One landowner on Boyer’s Creek and 3 landowners on Elsie Creek did not grant permission to access the creek on their property. Sites were selected to represent historic sample sites and all available summer resident fish habitats in the tributary sections (headwaters, mid reach and mouth). For intermittent tributaries 1 to 3 stations were sampled within each tributary. The total amount of available summer fish habitat was determined for each tributary by visually inspecting the watercourse to establish an aerial limit of open water and calculating the habitat area manually using tools in Arc Map GIS ©.

For all tributary stations the Depletion Method (Carle and Strub, 1978) was used to estimate biomass (kg/ha and N/ha). A minimum of three passes (runs) with declining catches were conducted within a sample length (30m or 50m) defined by both upstream and downstream blocker nets. This is the same methodology used in historic studies (1965, 1974, 1979 and 1984) and therefore important for trend through time information. Additional runs were required when catch results did not decline. When this happened it was assumed that the sampling technique was less effective than usual, and these runs were included in the analysis for standing crop. An iterative program was developed to estimate station abundance (standing crop) as per the Depletion Method (Carle and Strub, 1978), allowing 3, 4, 5 and 6 runs to be used in the calculation.

### 3.2.1 Seining

The 30m station limits were measured using a tape measure along the bank. The station was not disturbed until the blocker nets were installed. The downstream blocker net (3/16th inch mesh) was secured first followed by the upstream blocker net. The lead lines were further tampered down with available rocks or logs to ensure no fish would enter or exit the site during the sampling procedure. Either a seven or a fifteen metre seine net, with 3/16 inch mesh, was then used to seine the creek. Creek width determined seine net choice. To seine the site, one person was at each end of the seine net, holding the end of the float line and securing the end of the lead line to his/her foot. Starting from the downstream end, the seine was swept through the creek section, keeping the net ends as close to the creek sides as possible and keeping the lead line to the bottom of the creek. Once the upstream blocker net was reached, the seine ends were gathered together and the collected fish were transferred into a holding pen while two more runs were completed by the same people, keeping each run in a separate holding pen. The collected fish were kept in floating holding pens upstream of the station while completing subsequent runs to reduce stress on the fish and to maintain control of all previously captured fish. Once three runs were completed, the fish were separated by species for each run and sampled. If a decreasing count was not achieved additional runs were completed.

### 3.2.2 Back Pack Electrofishing

All operations were carried out using standard OMNR electrofishing policy. Sampling using the Smith Root Type LR-24 backpack electrofisher was completed in a similar fashion for each station. A fifty metre station was measured along the bank and upstream and downstream blocker nets were installed as described above. The backpack electrofisher was tested outside the station to determine its appropriate effective settings. The pulse width, voltage and frequency were recorded. One technician carried the backpack electrofisher and a bucket of water, while two technicians would walk on either side with nets to collect immobilized fish. As fish were collected, they were placed into the bucket of water. Electrofishing effort was standardized in terms of electric output or power and a consistent search effort for each sample run within a station. Runs were continued until three decreasing runs were completed, with the fish stored from each run in separate holding pens until sampling time.

## 3.3 *FISH SAMPLING*

All fish were counted, measured total length (TL) ( all species), fork length (FL) (sport fish only) and those readily identifiable to species level were live released near the capture site, except for fish samples collected for the MOE/MNR Sport Fish Contaminant monitoring program. Boat sampling was not conducive for individual weight measures. Weights were taken on board when possible. Weight data gaps were estimated from base line length - weight regression data for these waterbodies. Unidentified species and representative samples of small fish less than 100 mm were preserved in 80% ethanol, counted and measured and recorded on OMNR Field Collection Records and later transported to the Royal Ontario Museum (ROM) for species and hybrid identification. For tributary sampling all small fish were grouped by species and weighed. Larger fish were individually weighed and scale samples collected from sport fish. DNA samples (hole punch in dorsal fin) were collected for all walleye captures to verify stock origin.

## 3.4 OTHER PARAMETERS

Information regarding habitat, water depth, substrate, vegetation, shoreline cover, water colour, water clarity, water and air temperature were collected. Dissolved Oxygen and conductivity were measured using an YSI model 550A. Photographs of the station and some fish specimens were taken. Station location was determined using a hand held Geographic Position Satellite (GPS) unit, recorded on field notes and base maps and later ortho rectified in Arc Map ©. After sampling was complete, the cross-section of the tributary station was measured by dividing the station lengthwise into five sections. At each section, the wetted width of the creek and the water depth at three equally-divided points along the width were measured. Field data was transposed onto OMNR Field Collection records, catch record tables and photographs were compiled into a binder that is maintained at the MNR Niagara Area office.

## 3.5 NIAGARA AREA FISH DATABASE

All field data including photographs were entered into a locally designed Arc Map GIS Microsoft Access database for spatial analysis and exported to Microsoft Excel for statistical analysis. Unidentified species were entered by genus and any identification data obtained from samples submitted to the ROM were updated into the tables and GIS database upon receipt.

## 3.6 DATA ANALYSIS

Data analysis included the following manipulations; relative abundance as mean N/1000s for main stem ARAs for a single sampling season. Each station catch was standardized to 1000 electroshocking seconds before a mean for the ARA was calculated.For tributary station comparisons, electrofishing effort was standardized to 1000 electrofishing seconds per run (where effort was recorded) within a 50m station length. Seine netting was standardized to 30m sections, (unless 30m was not available), and were standardized to that reach length/station. When a combination of seining and electrofishing was used on different stations within a tributary, uncorrected (total catch) values were used to estimate overall relative abundance (N/m).Estimated length of residual habitat was determined by a combination of known extent of wet habitat as observed in the field and from measurements in the GIS map software with the aid of air photograph layers. Residual habitat, as hectares, was calculated using the mean wetted width measured in the field and the estimated length of habitat.

Data Assumptions

- All data is considered to represent summer resident (low flow) distribution and abundances.
- Historic records were limited to historic MNR survey results[2], or verified historical species occurrences from the Royal Ontario Museum fisheries database. This screening of historical inclusions was considered appropriate to accurately portray a species pool for each of the main areas of the watershed.
- Fish community metric changes over time (>5%) minimum was in discussion.

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[2] MNR fisheries survey protocol is to send any species of questionable identification to the Royal Ontario Museum for identification or verification.

# 4 SAMPLING RESULTS

## 4.1 LOWER NIAGARA RIVER

Five shoreline stations were electrofished by boat from Queenston to Niagara-on-the-Lake in September 2004. This sampling constitutes the first MNR electrofishing survey in this part of the river and covers the only accessible portion of the Canadian river safe for boat electrofishing.  The surveyed area covers approximately 10 km of shoreline with fast flows, clear water over rocky, gravelly substrate with some weed beds dominated by *Vallisneria* sp., and several current back eddies (Figure 20). Sampling at each station covered approximately 500m of river shore length over the duration of 1000 electrofishing seconds. Sampling rate was 250m/km of shoreline just above the mean 226m/km for all large waterbody ARAs in this study.

Fish presence and absence observations in 2004 as well as historic data are shown in Table 1. Historic data includes MNR and Royal Ontario Museum (ROM) records of fish species captured using a variety of field techniques including trap nets, seine, creel surveys, commercial fish harvest, gill net sets, baited hook and line, and bottom and midwater trawling of the Niagara Bar.  Historic and current records from the New York Department of Environmental Conservation (NYDEC) are also included for community reference.

**Figure 20 Lower Niagara River Sampling Locations**

The currently accepted Lower Niagara River species pool is comprised of 73 species not including extinct or extirpated species[3]. The species pool in the Lower Niagara River differs from the rest of the Niagara River watershed due to the connection to Lake Ontario and the natural migration barrier at Niagara Falls. Species unique to Lower Niagara River include kiyi (extirpated), deepwater sculpin, slimy sculpin, three-spine stickleback, american eel, atlantic salmon, lake trout, lake herring, and four introduced sportfish – coho salmon, chinook salmon, rainbow trout and brown trout.

Boat electrofishing collected 35 of the 73 species recorded for the lower Niagara River. These results represent a sampling technique bias and not a decline in species diversity.  Many fish immobilized in the

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[3] The species pool is comprised of verified MNR captures from the river, ROM historical records, literature review and consultation with other agencies studying Ontario Fisheries distribution. Species will continue to be introduced, or to expand their natural ranges, such that the definitive species pool is not a static number.

electrical current were swept downstream with the river flow and not netted. Also, comparison of the historic species and those captured in 2004 indicated electrofish sampling did not capture species occupying deep bottom and midwater habitats such as lake sturgeon, sculpins, herring, whitefish, most salmonids, burbot, sea lamprey, most sucker species, dace, most darter species, walleye and muskellunge. Therefore fish abundance and diversity results should be review considering this bias. For example, US diving studies for lake sturgeon find most of these fish in about 9m water depth – well out of the range of boat electrofishing (Lowrie, 1999)

Six species captured not previously recorded within the Ontario waters are: banded killifish, river chub, creek chub, rosyface shiner, green sunfish and the exotic round goby (Table 1). Round goby is a recent non native species that first appeared in the watershed after 1999.

American eel was once abundant in the Lower Niagara River and now is in global decline similar to all Anguilidae. The American eel is now a Species-at-Risk in Canada (COSEWIC- Threatened) [4]. Historic commercial fishing for American eel, yellow perch, rainbow smelt, sunfish, channel catfish and suckers occurred in this water body. Commercial bait harvest remains active.

**Table 1 Species Abundance & Presence/Absence Lower Niagara River**

| **COSEWIC** | **Common Name** | **Scientific Name** | **Electro-fishing** 2004 5stns | **MNR Historic Surveys** | **ROM Historic Record** | **Anecdotal reports or Creel survey** | **N.Y. DEC**[5] |
|---|---|---|---|---|---|---|---|
| THR | Lake Sturgeon | *Acipenser fulvescens* | | | | + | + |
| | Gizzard shad | *Dorosoma cepedianum* | 0.15% | + | | | |
| | Rainbow Smelt | *Osmerus mordax* | 1.25% | + | + | | + |
| | Central Mudminnow | *Umbra limi* | | | | | + |
| THR | American Eel | *Anguilla rostrata* | | + | | | + |
| | Lake Whitefish | *Coregonus clupeaformis* | | | | + | |
| | Lake Herring | *Coregonus artedi* | | + | | + | |
| XT | Kiyi | *Coregonus kiyi* | | | + | | |
| | Longnose Sucker | *Catostomus catostomus* | | + | | | |
| | Northern Hognose Sucker | *Hypentelium nigricans* | | + | + | | + |
| | Golden Redhorse | *Moxostoma erythrurum* | | | + | + | |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | + | + | | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | | | + | | |
| | White sucker | *Catostomus commersoni* | 5.85% | + | + | | + |
| | Redhorse sp. | *Moxostoma sp.* | 0.53% | + | + | | |
| | Yellow Bullhead | *Ameiurus natalis* | | | + | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.58% | + | | | + |
| | Channel Catfish | *Ictalurus punctatus* | | + | | | |
| | Stonecat | *Noturus flavus* | | | | | |
| | Tadpole Madtom | *Noturus gyrinus* | | | + | | |
| | Banded Killifish | *Fundulus diaphanus* | 0.89% | | | | |
| | Burbot | *Lota lota* | | + | | + | |
| | Trout-perch | *Percopsis omiscomaycus* | 0.07% | + | | | |
| | White Perch | *Morone americana* | 3.33% | + | + | | + |
| | White Bass | *Morone chyrsops* | | + | + | | + |
| | Rainbow Darter | *Etheostoma caeruleum* | 0.14% | + | | | + |
| | Fantail Darter | *Etheostoma flabellare* | | | + | | + |
| | Johnny Darter | *Etheostoma nigrum* | | + | + | | + |
| | Logperch | *Percina caprodes* | | + | + | | + |
| | Blackside Darter | *Percina maculata* | | | + | | |
| | Tesselated Darter | *Etheostoma olmstedi* | | | + | | |
| | Freshwater Drum | *Aplodinotus grunniens* | 0.29% | + | + | | + |
| | Mottled sculpin | *Cottus bairdi* | | + | + | | |

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[4] Note: species status is updated frequently please check with the Department of Fisheries and Oceans for updated information http://www.dfo-mpo.gc.ca/species-especes/species/species_searchSpecies_e.asp

[5] US Department of Environmental Conservation, New York State

| COSEWIC | Common Name | Scientific Name | Electro-fishing 2004 5stns | MNR Historic Surveys | ROM Historic Record | Anecdotal reports or Creel survey | N.Y. DEC$^5$ |
|---|---|---|---|---|---|---|---|
| | Slimy Sculpin | *Cottus cognatus* | | + | | | |
| SC | Deep water sculpin | *Myoxocephalus thompsoni* | | | + | | |
| | Hornyhead Chub | *Nocomis biguttatus* | | | + | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 0.65% | | + | | + |
| | Emerald Shiner | *Notropis atherinoides* | 18.27% | + | + | | |
| | River Chub | *Nocomis micropogon* | 0.43% | | | | + |
| | Common Shiner | *Luxilus cornutus* | 0.12% | + | | | |
| | Spottail Shiner | *Notropis hudsonius* | 1.04% | + | + | | + |
| | Rosyface Shiner | *Notropis rubellus* | 0.14% | | | | |
| | Spotfin Shiner | *Notropis spiloterus* | | | + | | |
| | Sand Shiner | *Notropis stramineus* | | | + | | |
| | Mimic Shiner | *Notropis volucellus* | | + | | | |
| | Bluntnose Minnow | *Pimephales notatus* | 5.82% | + | + | | + |
| | Fathead Minnow | *Pimephales promelas* | 0.15% | | | | |
| | Longnose Dace | *Rhinichthys cataractae* | | + | | | + |
| | Creek Chub | *Semotilus atromaculatus* | 0.48% | | | | |
| | Striped Shiner | *Luxilus chrysocephalus* | | | + | | |
| | Chub sp | *Semotilus sp* | 0.62% | | | | |
| XT-RIN | Atlantic Salmon | *Salmo salar* | | | | + | |
| | Lake Trout | *Salvelinus namaycush* | | + | | + | + |
| | Northern Pike | *Esox lucius* | 0.31% | + | | | + |
| | Muskellunge | *Esox masquinongy* | | + | | + | + |
| | Smallmouth Bass | *Micropterus dolomieui* | 1.97% | + | | | + |
| | Largemouth Bass | *Micropterus salmoides* | 10.10% | + | + | | + |
| | White Crappie | *Pomoxis annularis* | | | + | | |
| | Black Crappie | *Pomoxis nigromaculatus* | 0.07% | + | | | |
| | Yellow Perch | *Perca flavescens* | 19.22% | + | + | | + |
| | Walleye | *Stizostedion vitreum* | | + | + | + | + |
| | Rock Bass | *Ambloplites rupestris* | 8.37% | + | + | | + |
| | Green Sunfish | *Lepomis cyanellus* | 2.37% | | | | |
| | Pumpkinseed | *Lepomis gibbosus* | 0.24% | + | + | | |
| | Bluegill | *Lepomis macrochirus* | 0.34% | + | | | |
| | Sea Lamprey | *Petromyzon marinus* | | + | | + | |
| | Alewife | *Alosa pseudoharengus* | 0.07% | + | + | | + |
| | Coho Salmon | *Oncorhynchus kisutch* | | + | + | + | |
| | Chinook Salmon | *Oncorhynchus tshawytscha* | 0.58% | + | | + | + |
| | Rainbow Trout | *Oncorhnchus mykiss* | | + | | + | + |
| | Brown Trout | *Salmo trutta* | | | | + | + |
| | Goldfish | *Carassius auratus* | 0.07% | + | + | | + |
| | Common Carp | *Cyprinus carpio* | 0.29% | + | + | | + |
| | Three-spined Stickleback | *Gasterostius aculeatus* | | + | + | | + |
| | Round Goby | *Neogobius melanostomus* | 15.19% | | | | |
| | Carp-Goldfish Hybrid | | | + | | | |
| Ext | Blue Walleye | *Stizostedion vitreum glaucum* | | | | + | |
| LXT | Brook Trout | *Salvelinus fontinalis* | | | | + | |
| | **# Species^** | **73** | 35 | 46 | 29 | | 35 |
| | **#fish caught** | | 688 | | | | |
| | **Mean #fish/1000ES** | | 138 | | | | |

^Total species does not include genus-only listings, hybrid listings, or Extinct and Extirpated species

**Legend for Table 1**

| | | | |
|---|---|---|---|
| + | Denotes presence | NAR | Not at Risk |
| + | From Mandrak and Crossman 2000 Distribution Maps | SC | Special Concern |
| 🟩 | Native Minnow family & darters | SC* | Rank Being considered |
| 🟨 | Sunfish family (other than sportfish) | T | Threatened |
| 🟧 | Native sportfish | XT | Extirpated |
| 🟦 | Exotic species, including exotic sportfish | XT-RIN | Extinct - reintroduced |
| 🟪 | Extinct and or locally extirpated from this part of Lake Ontario Watershed | Ext LXT | Extinct-Locally extirpated |
| ⬜ | Sucker Species | END | Endangered |

## *4.2 UPPER NIAGARA RIVER*

The Upper Niagara River shoreline is approximately 24.5 km long. Previous shoreline electrofishing occurred at 7 stations in 1999 by the MNR-Lake Erie Unit. Sampling covered the upper two-thirds of the area extending from the head of the river to as far downstream as Black Creek. Sampling included both day and night efforts. In 2004 due to time constraints sampling was limited to three shoreline stations from Chippawa to Fort Erie concentrating on tributary mouths associated with Usshers Creek, Boyer's Creek and Miller Creek. In 2008, the 3 stations from 2004 were repeated and 2 new stations were sampled around Navy Island (Figure 21). Boat electrofishing in 2004 and 2008 at each station covered approximately 500m of river shore length over the duration of 1000 electrofishing seconds. Stations were selected within 3 m of the shoreline however the boat was sometimes forced to stay further from the shoreline in areas with shallow water, flat slope and presence of boulders. No excessive flows were encountered however small fish abundances may be under represented especially in dense weed bed areas. In 2004, Upper Niagara River sampling rate was 163.3 m/km, below the average 226m/km for all large waterbody ARAs. Mean CPUE was 290 N/1000ES +- 147 (95%CL) indicating a high variance between stations.

**Figure 21 Upper Niagara River Sampling Locations indicating sampling associated with tributary discharges**

Fish abundances from 2004 and 2008 are shown in Table 2, as well as presence absence from 1999 and Royal Ontario Museum (ROM) records of fish species captured using a variety of field techniques including, seine, creel surveys, commercial fish harvest and gill net sets. The historic ROM records are presented in detail in Appendix C. Also in Table 2 are historic and current records from the New York Department of Environmental Conservation (NYDEC) included for community reference. The US sampling comes from a number of studies using multiple techniques and is presented as a species pool reference. The column furthest to the right shows presence/absence in the 5 direct tributaries of the Upper Niagara River (Frenchmans, Miller, Boyers, Black and Usshers Creeks).

Combined sampling in 2004 and 2008 boat electrofishing identified 43 of 73 known species known from the upper river including American brook lamprey collected in 2008 from the weed beds between Boyers and Black Creeks. Collection of American brook lamprey was significant given their status and difficulty of capture using electrofishing techniques, as they are usually burrowed into the substrate. Lake sturgeon of the Lower Great lakes (COSEWIC – Threatened), are also considered threatened in New York State and endangered in Pennsylvania and Ohio. No sturgeon were caught with MNR gear but US diving studies from 1994 – 1997 indicate use of the Upper Niagara River by this population. Sitings in Canadian waters of the Niagara River extend along the entire length of the river and into the Chippawa Channel. The US studies indicate successful reproduction in the river based on sitings of juveniles every year. Their studies found some concentration of sturgeon around the discharge of Frenchman's Creek. A map of sitings is provided in Appendix A (Lowrie, 1999).

Fish listed as redhorse species were YOY redhorses sent to ROM, which could not be verified to species. The sucker family is represented by 5 species in recent sampling, including juvenile golden redhorse collected from around Boyer's Creek and the south end of Grand Island. YOY northern hog sucker was associated with the Boyer's Creek station, Ussher's Creek station and the north side of Grand Island. Greater redhorse was collected from stations asscociated with the mouths of Miller Creek, Usshers Creek, and Boyer's Creek, as well as both stations around Grand Island. Shorthead redhorse werre associated with stations crossing the mouths of Ussher's and Boyer's creeks, but YOY are found in within the lower reaches of all 5 tributaries of the Upper Niagara River. White sucker were found in all surveyed sections of the Upper Niagara River.

Sampling at the mouth of Frenchman's Creek in 2004 yielded a large muskellunge (810mm total length) and yoy smallmouth bass, YOY largemouth bass and YOY white sucker. As noted below in the report section on Frenchman's Creek, local fishermen have noticed a shift in Niagara River muskellunge distribution toward Frenchman's Creek in recent years since restoration work in that subwatershed. Qualitative sampling in 1999 found adult pike in weed beds along the shore of the river near Miller's Creek and the Niagara Parks Marina, and adult walleye between the same marina and Frenchman's Creek. (data not shown). A YOY muskellunge was observed, but not captured at one of the stations around Navy Island. The single walleye collected in 2008 from the river near Boyer's Creek was a juvenile. Greater redhorse, shorthead redhorse and hornyhead chub were verified by ROM.

Collections also include two exotic species round goby and rudd not collected in historic studies. Rudd is a recent invasive species that was first detected in St Lawrence River in 1989 and first collected from the Buffalo River (Upper Niagara River tributary) in 1991. Recent sampling in the Upper Niagara River by the New York Department of Environmental Conservation found rudd to compromise up to 38% of the catch in littoral areas of the shoreline, and their studies indicated rudd inhabit both lentic and lotic areas (Kapuscinski et al, 2012).

There were no large gaps in species representation, but some sampling bias likely occurs similar to sampling in the Lower Niagara River. Boat electrofishing did not capture species occupying deep bottom and midwater habitats such as lake sturgeon, sculpin, herring, whitefish, most salmonids, burbot, dace and some darter and shiner species. For example sampling captured only 8 of 21 native minnows and 2 of 5 darters. In 1999 five stations were sampled at night, and sampling areas included large weed beds of *Vallisneria* sp. When comparing fish community assemblage, the 1999 sampling underestimated the number of small fish especially benthic species, showing a bias toward the capture of large fish, especially large predators and omnivores. This difference reinforces the need to keep variables such as sampling time of day consistent between sample years. In all cases, high flows reduce catchability of stunned fish.

# Table 2 Species Abundance & Presence/Absence Upper Niagara River

| COSEWIC | Common Name | Scientific Name | 2008 Sep 5stns | 2004 Sep 3stns | 1999 MNR | ROM Historic Record | Anecdote or creel surveys | N.Y. DEC | Tribs 2003-2009 |
|---|---|---|---|---|---|---|---|---|---|
| | American Brook Lamprey | *Lampetra appendix* | 0.2% | | | | | + | |
| | Sea Lamprey | *Petromyzon marinus* | | | | | | + | |
| THR | Lake Sturgeon | *Acipenser fulvescens* | | | | | + | + | |
| | Longnose Gar | *Lepisosteus osseus* | | | | | | + | + |
| | Bowfin | *Amia calva* | | 0.1 % | + | | | + | + |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | + | + |
| | Central Mudminnow | *Umbra limi* | | | | | | + | + |
| | Mooneye | *Hiodon tergisus* | | | | | | + | |
| THR | American Eel | *Anguilla rostrata* | | | | | | + | |
| | Quillback Carpsucker | *Carpiodes cyprinus* | | | | + | | + | |
| | White sucker | *Catostomus commersoni* | 19.8% | 8.5% | + | + | | + | + |
| END | Lake Chubsucker | *Erimyzon sucetta* | | | | | | + | |
| | Northern Hog Sucker | *Hypentelium nigricans* | 0.6% | 0.7% | | + | | + | |
| | Black Redhorse | *Moxostoma duquesnei* | | | | | | + | |
| | Silver Redhorse | *Moxostoma anisurum* | | | | | | + | + |
| | Golden Redhorse | *Moxostoma erythrurum* | 0.3% | | | | | + | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | 0.3% | 0.3% | | + | | + | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | 2.3% | 1.4% | | + | | + | + |
| | Redhorse Species | *Moxostoma sp.* | 0.6% | 0.6% | + | | | | |
| | Black Bullhead | *Ameiurus melas* | | 0.3% | | | | + | + |
| | Yellow Bullhead | *Ameiurus natalis* | | | | | | + | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.6% | 1.5% | + | | | + | + |
| | Stonecat | *Noturus flavus* | | | + | | | + | |
| | Tadpole Madtom | *Noturus gyrinus* | | | | | | + | + |
| | Brindled Madtom | *Noturus miurus* | | | | | | + | |
| | Burbot | *Lota lota* | | | | | | + | |
| | Brook Silverside | *Labidesthes sicculus* | | | | | | + | + |
| | Brook Stickleback | *Culaea inconstans* | | | | | | + | + |
| | Three-spine Stickleback | *Gasterosteus aculeatus* | | | | | | + | |
| | Ninespine Stickleback | *Pungitius pungitius* | | | | | | + | |
| | Trout-perch | *Percopsis omiscomaycus* | | 0.1% | + | | | + | |
| | White Bass | *Morone chrysops* | | | + | + | | + | |
| | Greenside Darter | *Etheostoma blennioides* | | | | | | + | |
| | Rainbow Darter | *Etheostoma caeruleum* | 0.1% | | | + | | + | + |
| | Iowa Darter | *Etheostoma exile* | | | | | | + | |
| | Fantail Darter | *Etheostoma flabellare* | | | | | | + | |
| | Johnny Darter | *Etheostoma nigrum* | 0.2% | 0.2% | + | + | | + | + |
| | Logperch | *Percina caprodes* | 0.4% | 0.2% | + | | | + | |
| | Freshwater Drum | *Aplodinotus grunniens* | | 0.3% | + | | | + | + |
| | Mottled sculpin | *Cottus bairdi* | 0.2% | | | + | + | + | |
| | Hornyhead Chub | *Nocomis biguttatus* | 0.8% | 0.8% | | + | | + | + |
| | River Chub | *Nocomis micropogon* | | | | | | + | |
| | Golden Shiner | *Notemigonus crysoleucas* | 1.5% | 2.8% | + | + | | + | + |
| | Emerald Shiner | *Notropis atherinoides* | 4.6% | 19.4% | + | + | | + | + |
| | Common Shiner | *Luxilus cornutus* | 3. 5% | 11.8% | + | + | | + | + |
| | Striped Shiner | *Luxilus chrysocephalus* | 0.3% | 0.2% | | + | | + | + |
| | Blackchin Shiner | *Notropis heterodon* | | | | | | + | |
| | Blacknose Shiner | *Notropis heterolepis* | | | | | | + | |
| | Spottail Shiner | *Notropis hudsonius* | 20.6% | 5.3% | + | + | | + | + |
| | Spotfin Shiner | *Notropis spiloterus* | | | | + | | + | |
| | Sand Shiner | *Notropis stramineus* | | | | | | + | |
| | Redfin Shiner | *Lythrurus unbratilis* | | | | | | + | |
| | Mimic Shiner | *Notropis volucellus* | | | | | | + | |
| | Bluntnose Minnow | *Pimephales notatus* | 16.0% | 23.3% | + | + | | + | + |
| | Fathead Minnow | *Pimephales promelas* | | | | | | + | + |
| | Blacknose Dace | *Rhinichthys atratulus* | | | | | | + | + |
| | Longnose Dace | *Rhinichthys cataractae* | | | | | | + | + |
| | Lake Chub | *Couesius plumbeus* | | | | | | + | |
| | Creek Chub | *Semotilus atromaculatus* | 0.3% | 0.2% | | | | + | + |
| | Fallfish | *Semotilus corporalis* | | | | | | + | |
| NAR | Central Stoneroller | *Campostoma anomalum* | | | | + | | + | + |
| | Lake Trout | *Salvelinus namaycush* | | | | | | + | |
| | Northern Pike | *Esox lucius* | 0.3% | 0.1% | + | | | + | + |
| | Muskellunge | *Esox masquinongy* | 0.2% | | + | | + | + | + |

| COSEWIC | Common Name | Scientific Name | 2008 Sep 5stns | 2004 Sep 3stns | 1999 MNR | ROM Historic Record | Anecdote or creel surveys | N.Y. DEC | Tribs 2003-2009 |
|---|---|---|---|---|---|---|---|---|---|
| | Smallmouth Bass | *Micropterus dolomieui* | 0.9% | 0.3% | + | | | + | + |
| | Largemouth Bass | *Micropterus salmoides* | 3.8% | 3.9% | + | | | + | + |
| | White Crappie | *Pomoxis annularis* | | 0.1% | | | | + | + |
| | Black Crappie | *Pomoxis nigromaculatus* | | | | + | | + | + |
| | Yellow Perch | *Perca flavescens* | 11.6% | 4. 5% | + | + | | + | + |
| | Sauger | *Stizostedion canadense* | | | | | | + | |
| | Walleye | *Stizostedion vitreum* | 0.1% | | + | | + | + | |
| | Rock Bass | *Ambloplites rupestris* | 2.3% | 4.4% | + | + | | + | + |
| | Green Sunfish | *Lepomis cyanellus* | | 0.2% | | | | + | + |
| | Pumpkinseed | *Lepomis gibbosus* | | 0. 9% | + | | | + | + |
| | Bluegill | *Lepomis macrochirus* | 0.1% | 0.2% | + | | | + | + |
| | Longear Sunfish | *Lepomis megalotis* | | | | | | | + |
| | Round Goby | *Neogobius melanostomus* | 2.6% | 2.4% | | | | + | + |
| | Banded Killifish | *Fundulus diaphanus* | 0.1% | | | + | | + | + |
| | Alewife | *Alosa pseudoharengus* | | | + | + | | + | + |
| | Gizzard shad | *Dorosoma cepedianum* | 0.8% | 1.4% | + | | | + | + |
| | White Perch | *Morone americana* | 1.9% | 0.1% | + | | | + | |
| | Coho Salmon | *Oncorhynchus kisutch* | | | | | | + | |
| | Chinook Salmon | *Oncorhynchus tshawytscha* | | | | | | + | |
| | Rainbow Trout | *Oncorhnchus mykiss* | | | + | | + | + | |
| | Brown Trout | *Salmo trutt* | | | | | + | + | |
| | Rainbow Smelt | *Osmerus mordax* | 0.1% | | | + | | + | |
| | Goldfish | *Carassius auratus* | 1.2% | 1.1% | + | | | + | + |
| | Common Carp | *Cyprinus carpio* | 1.0% | 2.1% | + | | | + | + |
| | Rudd | *Scardinius erythrophthalmus* | 0.6% | 0.1% | | | | + | |
| Ext | Blue Walleye | *Stizostedion vitreum glaucum* | | | | + | + | | |
| | TOTAL # Species^ | 87 | 35 | 35 | 30 | | | 87 | 48 |
| | #fish caught | | 1217 | 872 | | | | | |
| | MEAN #fish/1000ES | | 243 | 291 | | | | | |

^Total species does not include genus-only listings, hybrid listings, or Extinct and Extirpated species

**Legend for Table 2**

| | | COSEWIC | |
|---|---|---|---|
| + | Denotes presence | | |
| | | NAR | Not at Risk |
| 🟩 | Native Minnow family | THR | Threatened |
| 🟨 | Sunfish family (other than sportfish) | XT | Extirpated |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | | |
| 🟪 | Extinct | Ext | Extinct- |
| ⬜ | Sucker Species | END | Endangered |

### 4.2.1 Upper Niagara Tributaries

Sampling of Upper Niagara River tributaries covered the 6 major creek systems. Biomass sampling was first conducted by MNR in 1979 and included representative stations from Frenchmans Creek, Miller Creek, Bakers Creek, Boyers Creek and Black Creek. Usshers Creek was sampled in 1999. Periodic investigations by ROM and MNR occurred during the 1980's however this study represents the first comprehensive fisheries assessment since 1979. Land use changes since the late 1970's in these watersheds have changed the landscape significantly. Active farming has been reduced creating open to successional meadow, shrubland, wetland and forest communities. This is especially evident in the Town of Fort Erie and south Niagara Falls. Most industrial and residential development has occurred in the urban areas however, rural estate residential dwellings have also increased. In terms of fish habitat the most notable changes are an increase in habitat in Frenchman's Creek and Ussher's Creek which are now in part, permanent flowing systems. Therefore additional stations were selected to represent these resident habitats. Sampling employed the same methods as those used in the 1979 and 1999 studies of these tributaries. Historic studies and repeat sampling since 2003 (2004, 2005, 2007, 2008, 2009) are used to look at variation in sample years.

There were 51 species found resident in the tributaries. Five species were incidental, represented by 1 individual in 1 tributary (Table 3). Seventeen species were common to all of the Upper Niagara River tributaries (Table 4). These species are all commonly found in Ontario and were abundant in all the tributaries. Green sunfish appears in all of the tributaries in recent sampling, but none were collected in the 1979 and 1999 studies, and there are no ROM historic records of green sunfish for these tributaries. There is some debate as to whether green sunfish is native to the area (NYDEC, pers. comm., 2012).

Species found in the 1979 and 1999 studies that were not captured again in the recent sampling are listed in Table 5, showing the tributary that they are absent from. Five species from the sucker family are amongst this group. Greater redhorse, hornyhead chub and striped shiner were found in all or nearly all of the Niagara River tributaries in the early studies and are absent in recent surveys. These species are sensitive to poor water quality, and siltation of substrate prohibits successful spawning.

Sampling indicates the Upper Niagara tributaries are consistently used as spawning and rearing habitat for Niagara River sportfishes including muskellunge, northern pike, largemouth bass and smallmouth bass. Seldom are adults found in the tributaries, but young-of-the-year (YOY) and juveniles of these piscivorous fish are common at stations within the estuary habitat associated with the tributary mouths. The tributaries also provide spawning opportunities for migratory sucker species whose adult stages are in the Niagara River. This use is evident by capture of YOY white sucker, shorthead redhorse and silver redhorse. Sucker species use floodplain areas for spawning, a type of habitat limited in the Niagara River, and are consistently collected within the estuary habitat near the creek mouths.

Golden redhorse, greater redhorse and quillback carpsucker historically used these tributaries, and were collected in the main river stem, but were not collected in recent tributary sampling. Northern hog sucker, known as a common resident of flowing tributaries was not found in recent tributary surveys but identified in the main river. A relatively large group (40 YOY in 2005) of silver redhorse were found in Miller Creek, but otherwise they are absent from recent sampling. Most sucker species are lithophilic, found in association with clear water and gravel to rubble bottoms. Northern hognose, silver redhorse and greater redhorse are thought to have distribution limitations because they are also turbidity and sedimentation (siltation of the substrate) intolerant (Scott & Crossman, 1973 & Cosewic, 1989). Golden redhorse, historically in Miller Creek, is intolerant of pollutants, continuous turbidity and rapid siltation. It is also thought to be susceptible to changes that effect stream depth or flow velocity (fluctuating water levels) but it is commonly found in the Thames River, which records fluctuating turbidity, oxygen levels and temperature (COSEWIC, 1989, Edwards & Mandrak, 2006).

The Upper Niagara River tributaries also are periodically inundated with schools of Niagara River forage fish (emerald shiners, spottail shiners etc).Additionally, all the Upper Niagara tributaries with the exception of Frenchman’s Creek support populations of grass pickerel (COWESIC – Special Concern). The most abundant of these populations resides in Beaver Creek, a tributary of Black Creek.

Recent sampling (2003-2009) found Black Creek to hold the largest amount of summer resident fish habitat and the largest proportion of fish abundance followed by Frenchmans, Beaver and Miller creeks. Usshers, Boyers and Baker make up less than 25% of the remaining fish abundances during the summer resident season (Figure 22).

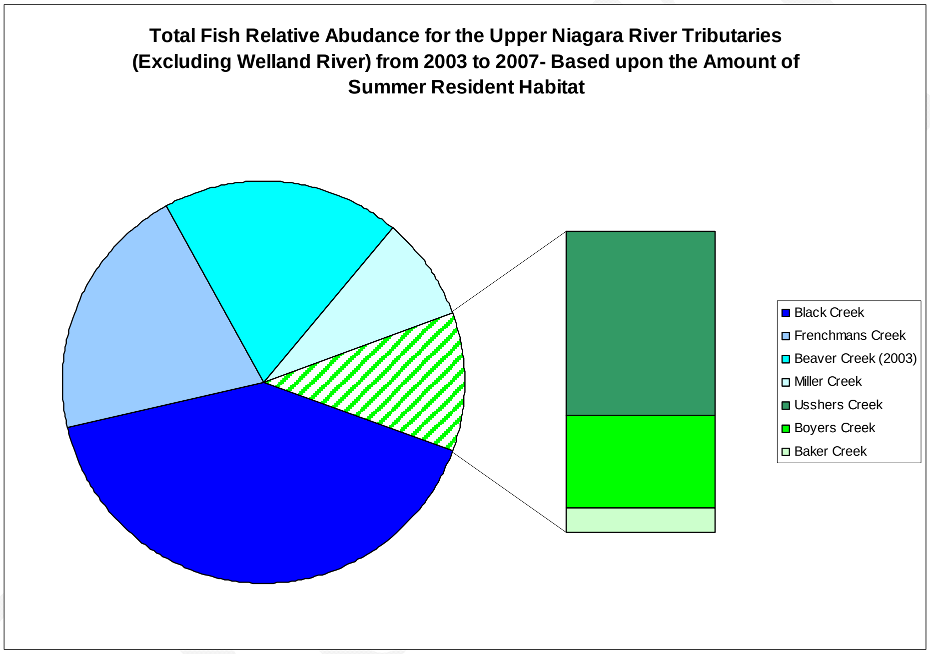

**Figure 22 Upper Niagara River Tributaries (excluding Welland River) Relative Abundance based upon total available Summer Resident Habitat**

**Table 3 Incidental species in Niagara River tributaries**

| | |
|---|---|
| Brassy Minnow | *Hybognathus hankinsoni* |
| Blacknose Dace | *Rhinichthys atratulus* |
| Longnose Dace | *Rhinichthys cataractae* |
| Central Stoneroller | *Campostoma anomalum* |
| Rainbow Darter | *Etheostoma caeruleum* |

**Table 4 Species common to all Niagara River Tributaries**

| | |
|---|---|
| Central Mudminnow | *Umbra limi* |
| White sucker | *Catostomus commersoni* |
| Golden Shiner | *Notemigonus crysoleucas* |
| Emerald Shiner | *Notropis atherinoides* |
| Common Shiner | *Luxilus cornutus* |
| Bluntnose Minnow | *Pimephales notatus* |
| Brown Bullhead | *Ameiurus nebulosus* |
| Rock Bass | *Ambloplites rupestris* |
| Green Sunfish | *Lepomis cyanellus* |
| Pumpkinseed | *Lepomis gibbosus* |
| Bluegill | *Lepomis macrochirus* |
| Johnny Darter | *Etheostoma nigrum* |
| Largemouth Bass | *Micropterus salmoides* |
| Northern Pike | *Esox lucius* |
| Yellow Perch | *Perca flavescens* |
| Goldfish * | *Carassius auratus* |
| Common Carp * | *Cyprinus carpio* |

*denotes non native species

**Table 5 Historic species not found in recent sampling in the respective tributaries.**

| | FreCk | MilCk | Bakers | Boyers | BlaCk | UssCk |
|---|---|---|---|---|---|---|
| Grass Pickerel | x | | | | | |
| Northern Hognose Sucker | | | | | | x |
| Shorthead Redhorse | | | | | x | |
| **Greater Redhorse** | **x** | **x** | **x** | **x** | | **x** |
| Golden Redhorse | | x | | | | |
| Quillback Carpsucker | | | | | | x |
| Stonecat | x | | | | | |
| **Hornyhead Chub** | **x** | | **x** | **x** | **x** | **x** |
| Spotfin Shiner | x | x | | x | | x |
| **Striped Shiner** | **x** | **x** | **x** | **x** | **x** | |
| Sand Shiner | | x | | x | | x |
| White Bass | x | | | | | |
| Log Perch | | x | | x | | |
| Mottled Sculpin | | x | | | | |
| River Chub | | x | | | | |
| Trout Perch | | | | x | x | x |
| Fantail Darter | | | | x | | x |
| Muskellunge | | | | x | | |

## Frenchmans Creek – Upper Niagara River Tributary

Frenchmans Creek has permanent summer flow from groundwater sources. Approximately half the length of creek traverses a broad, naturalized valley landscape. The other half crosses cultural land uses with minimal riparian edge (golf courses and farm fields). In the early 1990's the creek was subject to restorative work in the lower reaches to 1) improve baseflow with a better defined low flow channel, 2) remove low flow obstructions, and 3) implement erosion protection of banks to decrease bank failure and sediment loading to the creek. Following the creek improvements, fish community indicators of the alterations included observation of spawning northern pike (2002) and a major emerald shiner spring migration through the rehabilitated area in 1994. Within the Niagara River, local fishermen noted a shift in muskellunge distribution towards Frenchmans Creek mouth, and local scuba divers documented lake sturgeon feeding at the mouth of Frenchmans indicating an improved source of invertebrate drift and forage fish flushing from the creek for consumption by the larger Niagara River fish (Yagi et al, 2005). In 2009 an online dam in the upper reach of the creek was modified to allow upstream fish movement. Sampling after this remediation (2009 and 2011) indicated downstream dispersal of 3 species that were unique to the upstream section (central mudminnow, creek chub and fathead minnow). Young-of-the-year pike, young-of-the-year largemouth bass, brown bullhead, common shiner and round goby were found upstream of the remediation site, where they had not been caught previously.

Historic sampling includes ROM records and one station approximately 1km upstream of the creek mouth sampled in 1979 by bag seine. The 1979 station is within the widened reach affected by hydroelectric flow manipulation and represents a wider, more open-water habitat with sparse inwater cover compared to upstream reaches. Recent sampling repeats the location and method of the 1979 work, as well as comprehensive sampling in 2003 of 11 stations from the mouth to headwaters. Back pack electrofishing was used for all sites upstream of the repeat station. Sampling in 2009 was conducted to explore the upstream and downstream assemblages following dam remediation and did not include stations in the lower half of the creek (Figure 23).

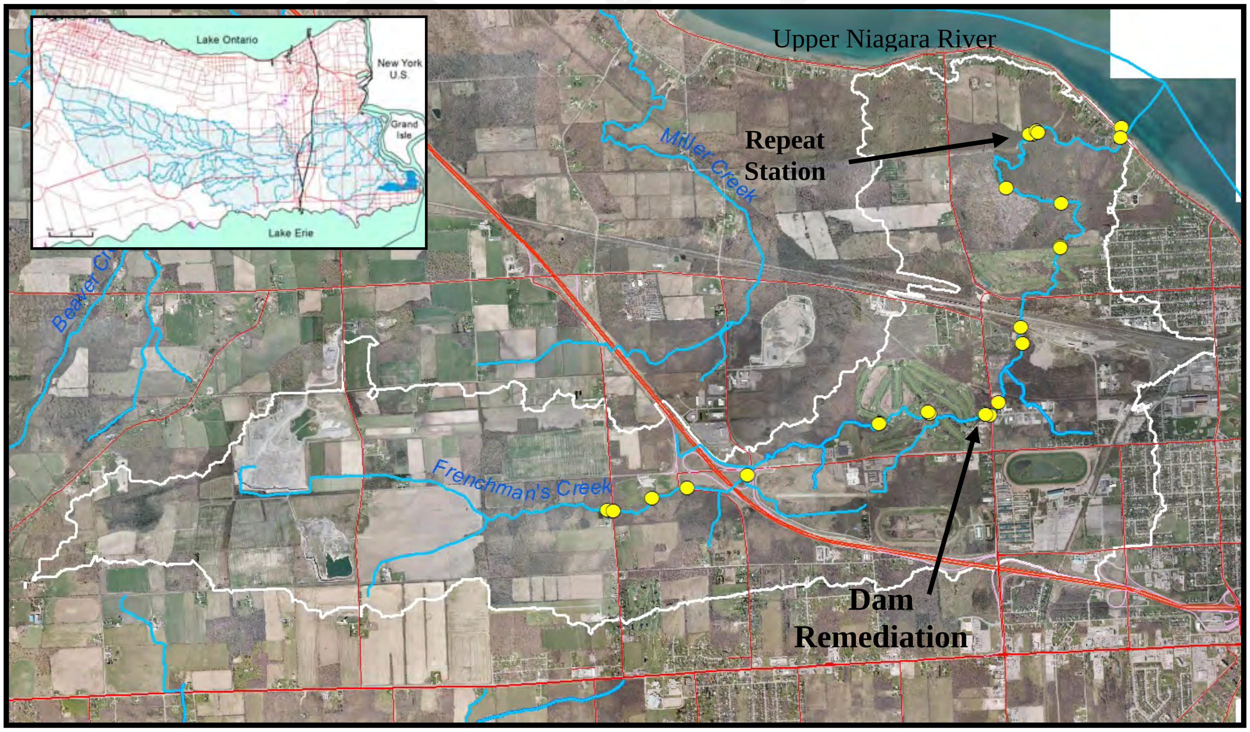

**Figure 23 Frenchman's Creek Sampling Locations**

Including historic records, 40 species are documented in Frenchmans Creek including 1 Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 6 exotics. Seven historic species not captured in recent sampling are indicated in red and include grass pickerel. Survey results are presented as relative abundance (Table 6). Comprehensive sampling in 2003 caught more than twice the number of species collected at the single repeat station, indicating the variety of habitat within the entire creek extent. Most of the increase in species richness in 2003 is associated with the station near the mouth at the interface between the creek and the Niagara River. This station includes YOY species associated with adults in the Niagara River – including YOY muskellunge, northern pike, white sucker (2003, 2004), shorthead redhorse and brown bullhead (2005). Also detected at the mouth are schools of emerald shiner, banded killifish, bluntnose minnow, rock bass, gizzard shad and round goby. Sampling at the repeat station sees periodic occurrences of schools of these species (i.e. schools of common shiner in 1979, YOY brown bullhead in 2005 and banded killifish in 2007). Piscivores are well represented in Frenchman’s creek though resident grass pickerel are notably absent from the system. What is evident is that Frenchman’s Creek is important juvenile habitat for Niagara River piscivores: northern pike and large mouth bass in the upper reaches, and muskellunge, largemouth bass and smallmouth bass near the creek mouth. Many of these fishes are in general too small to be piscivores at the time of the survey, but likely switch to a piscivorous diet while still in the creek. The collection of a piscivorous-sized pike (309mm) in 2011 from above the dam remediation site indicates not only a spread in their use of the creek, but also the suitability of the habitat for piscivorous-sized fish.

Frenchmans Creek in 1979 is not the same system as it is today due to the restorative work done in the 1990s. The 1979 station represents the only data previous to this work, and because it is within the influence of the hydroelectric fluctuation repeat sampling here may not show effects of stream rehabilitation. Some repeat sampling closer to the area of restorative work would better demonstrate restoration related changes.  Of note, in 2005 a second sampling after an industrial spill into the creek resulted in a decrease in biomass from 4,059.8 fish/ha to 246.6 fish/ha (data not shown). Reports of sand shiner (*Notropis stramineus*) and hornyhead chub in recent sampling outside of MNR work were unconfirmed. Hornyhead chub is known historically from Frenchmans Creek, but sand shiner would be a new addition to the species list for this tributary.

### Frenchmans Creek Summary

| | |
|---|---|
| Summer Flow regime: | Permanent base flow, 9.79km permanent residual creek length, ~5.95ha |
| Historic Data: | 1979 MNR survey 1 station. ROM historical records |
| Restorative Work | Lower Frenchmans Creek early 1990s - defined low flow channel, removed low flow obstructions, bank erosion protection. 2009 remove concrete dam. |
| Habitat | Fines in lower reaches, increasing substrate coarseness in mid reaches, dominance of fines in headwaters. Sparse to dense instream cover – vegetation/undercut banks/logs. Flows through extensive forested floodplains and cultured landscape |
| Fish Community Objectives: | Maintain base flow |
| | Maintain or increase resident minnow species diversity |
| | Maintain or increase resident sucker species |
| | Establish resident piscivorous species - explore reintroduction of Grass Pickerel |
| Manangement Recommendations: | Maintain  or improve connectivity to Niagara River |
| | Improve wetland habitat in backwater estuary to River |
| | Maintain previously designed habitat resoration projects in Lower Frenchmans |
| | Improve riparian habitat upstream of Bowen Road to Quarry |

## Table 6 Species Presence and Relative Abundance Frenchmans Creek

| | | | | | Repeat Station 2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COSEWIC | Common Name | Scientific Name | 2009 July 9stns | 2003 Jul/Aug 11stns | 2007 Oct | 2005 Aug | 2005 Jul | 2004 Sep | 2003 Jul-Aug | 1979 Aug | ROM |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | | | | + |
| | Central Mudminnow | *Umbra limi* | 4.4% | 2.8% | | 0.6% | 0.1% | | | | + |
| | White sucker | *Catostomus commersoni* | 9.8% | 15.0% | 0.2% | 21.8% | 15.6% | 23.3% | 60.9% | 16.5% | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | 5.6% | | | | | | | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | | | | | | | | | + |
| | Redhorse sp | *Moxostoma* sp. | | | | | | 1.0% | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.7% | 0.4% | | 35.9% | 61.5% | 1.0% | 4.5% | | + |
| | Stonecat | *Noturus flavus* | | | | | | | | | + |
| | White Bass | *Morone chyrsops* | | | | | | | | | + |
| | Johnny Darter | *Etheostoma nigrum* | 18.2% | 4.0% | | 0.1% | 4.2% | | 0.9% | | |
| | Brook Silverside | *Labidesthes sicculus* | | <0.1% | | | | | | | |
| | Brassy Minnow | *Hybognathus hankinsoni* | | 0.1% | | | | | | | |
| | Hornyhead Chub | *Nocomis biguttatus* | | | | | | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 0.3% | 2.4% | | | 0.8% | 3.9% | | | + |
| | Emerald Shiner | *Notropis atherinoides* | | 2.8% | | | | | | | + |
| | Common Shiner | *Luxilus cornutus* | 0.1% | <0.1% | 1.3% | | | 19.4% | | 42.7% | + |
| | Spottail Shiner | *Notropis hudsonius* | | 0.1% | | | | | | 11.7% | + |
| | Spotfin Shiner | *Notropis spiloterus* | | | | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 22.9% | 27.1% | 0.4% | | | 2.9% | 3.6% | 1.9% | + |
| | Fathead Minnow | *Pimephales promelas* | 17.9% | 0.1% | | 8.3% | 4.3% | 1.0% | | | + |
| | Blacknose Dace | *Rhinichthys atratulus* | | <0.1% | | | | | | | |
| | Longnose Dace | *Rhinichthys cataractae* | | 0.2% | | 3.2% | | | | | |
| | Creek Chub | *Semotilus atromaculatus* | 21.9% | 16.1% | | | | | 22.7% | 6.8% | + |
| NAR | Central Stoneroller | *Campostoma anomalum* | | | | 0.1% | | | | | + |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | | | | | | + |
| | Minnow | CYPRINIDAE | | | 0.9% | | | | | | |
| | Rock Bass | *Ambloplites rupestris* | | 1.9% | 2.3% | | | | | 1.0% | + |
| | Green Sunfish | *Lepomis cyanellus* | 3.0% | 0.6% | 0.6% | 1.3% | 0.6% | | 0.9% | | |
| | Pumpkinseed | *Lepomis gibbosus* | 0.8% | 0.3% | | | 0.5% | | 2.7% | | + |
| | Bluegill | *Lepomis macrochirus* | 0.4% | 3.1% | | | | | 1.8% | | + |
| | Northern Pike | *Esox lucius* | | 0.1% | | | | 1.0% | | 1.0% | + |
| | Muskellunge | *Esox masquinongy* | | <0.1% | | | | | | | + |
| | Smallmouth Bass | *Micropterus dolomieui* | | | | | | 5.8% | | | + |
| | Largemouth Bass | *Micropterus salmoides* | 0.2% | 0.3% | 0.4% | 25.6% | 11.6% | 22.3% | 1.8% | | + |
| | White Crappie | *Pomoxis annularis* | | <0.1% | | | | | | 1.0% | |
| | Yellow Perch | *Perca flavescens* | | 3.2% | | | | 5.8% | | 17.5% | + |
| | Round Goby | *Neogobius melanostomus* | 0.1% | 8.3% | 5.5% | | | 11.7% | | | |
| | Gizzard shad | *Dorosoma cepedianum* | | 2.3% | | | | | | | + |
| | Banded Killifish | *Fundulus diaphanus* | | 1.6% | 88.3% | | | | | | + |
| | White Perch | *Morone americana* | | 0.2% | | | | | | | + |
| | Goldfish | *Carassius auratus* | | 0.18% | | 0.6% | 0.6% | | | | + |
| | Common Carp | *Cyprinus carpio* | | 0.82% | | | | | | | + |
| | *TOTAL # SPECIES* | *40* | 14 | 31 | 9 | 10 | 10 | 12 | 9 | 9 | 32 |
| | *#fish caught* | | 1034 | 3375 | 469 | 156 | 965 | 103 | 110 | | |

Legend for Table 6

| | | COSEWIC Status | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | NAR | Nolonger at Risk |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | + | Denotes historic presence only |

## Miller Creek – Upper Niagara River Tributary

Miller Creek has approximately 3.55km of residual summer habitat. The creek is predominantly precipitation driven, but there are groundwater contributions at least in the upper reaches. The upper 2/3rds of the length is designated agricultural drain, but the creek for the most part runs through a naturalized wooded valley setting. Historic sampling includes ROM records and one station approximately 700m upstream of the creek mouth sampled in 1979 by bag seine. The repeat station is not within the influence of hydroelectric water control fluctation.

Recent sampling repeats the location and method of the 1979 work, as well as more comprehensive sampling in 2003 (3 stations) and 2009 (5 stations) to include a station at the mouth and sampling in the headwaters. Bag seine was used for all sites (Figure 24). Inwater cover is described as sparse to moderate with submergent and emergent vegetation.

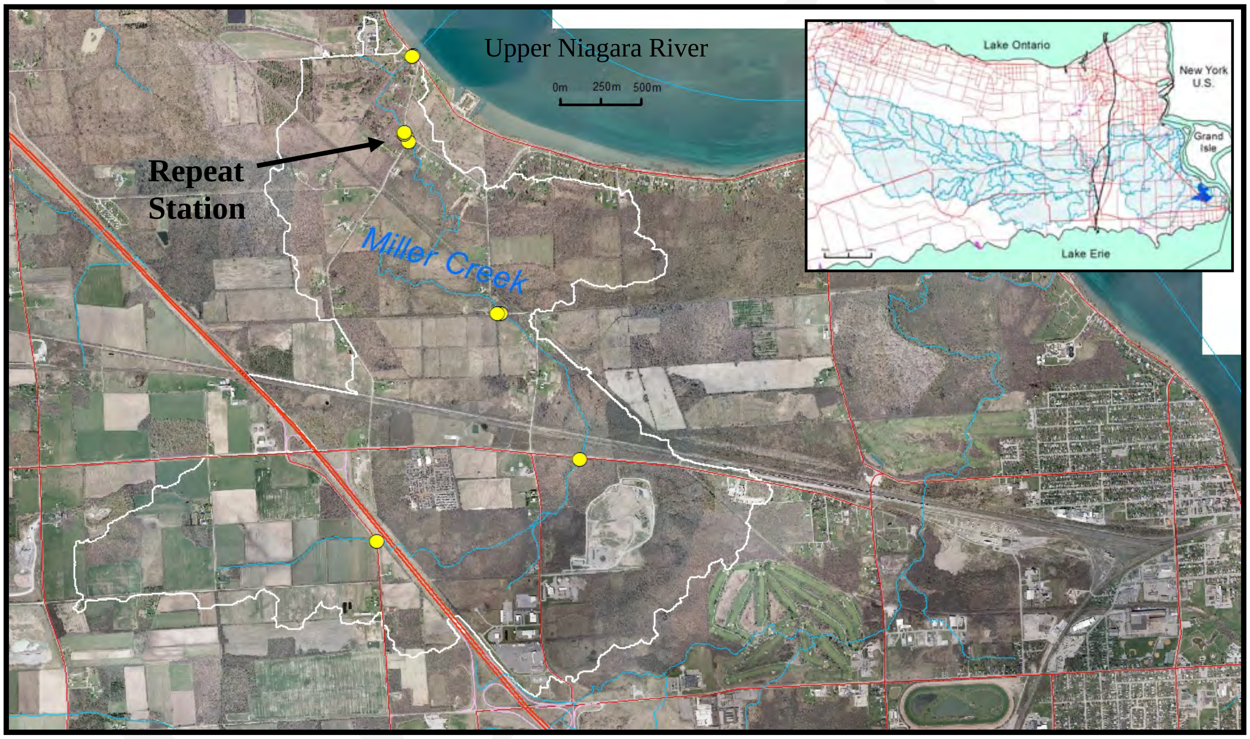

**Figure 24 Miller Creek Sampling Locations**

Survey results for all survey periods are presented in Table 7 as relative abundance. Forty-three species have been recorded from Miller Creek including one Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 6 exotics: common carp, goldfish, alewife, gizzard shad, banded killifish and round goby. Six historic native species not captured in recent sampling are golden redhorse, greater redhorse, logperch, mottled sculpin, river chub, and spotfin shiner (indicated in red, Table 7).

Repeat sampling at station 2 represents 32 species and notably includes a school of silver redhorse from sampling in 2005. Total catches indicate the dynamic range in total abundance associated with periodic movement of some fish (a run of emerald shiner in November 2009, and schools of gizzard shad and crappy in 1979). However, the repeat sampling does not capture all of the diversity of the species associated with the Niagara River such as gizzard shad, YOY shorthead redhorse, YOY muskellunge and YOY smallmouth bass, which were collected in years of comprehensive sampling that included sampling at the creek mouth.  Also of note from the comprehensive sampling in 2009 is brook stickleback collected from the most upstream station, within the portion designated as agricultural drain. Brook stickleback are almost exclusively associated with groundwater discharge and are indicative of groundwater contribution within this part of the Miller Creek.

All species captured through repeat sampling were captured in the comprehensive sampling, except grass pickerel. Similar to Frenchman’s Creek, Miller Creek has a notable absence of grass pickerel as a resident predator fish during most years of sampling. All records of smallmouth bass are juveniles and indicate the use of the creek for spawning and rearing of this species, but there is no evidence in the sampling to indicate if any of these remain as resident piscivores. The juvenile northern pike (2004) and a small portion of the largemouth bass collected in 2003 were of the size where forage fish would start to enter the diet.

Similar to Frenchman’s Creek, Miller Creek shows the same dynamic nature near its mouth with periodic inundations of schools of fish that have come in from the Niagara River. The run of banded killifish caught in Frenchamans Creek in 2007 is also seen in the 2007 sampling in Miller Creek, and sampling in November 2009 found over 2000 emerald shiner at the station near the creek mouth. A predominance of crappie caught in1979 is not seen again in recent sampling. Rather there appears to have been a shift to other sunfish (green sunfish, pumpkinseed, rock bass and bluegill). Cyprinid richness is highest in 2009 due to the inclusion of striped shiner (historical presence) and hornyhead chub (new for the watershed) as well as the more common species. Hornyhead chub was verified by ROM.

### Miller Creek Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent flow with 3.55km of permanent residual summer habitat, ~ 3.25ha |
| | No known migration barriers |
| Historic Data: | 1979 MNR survey 1 station. ROM historical records |
| Restorative Work | Friends of Fort Erie Creeks have done work to clear debris from Miller Creek |
| Habitat | Sparse to moderate instream cover – vegetation/logs.<br>Dominance of fine substrate. |
| Fish Community Objectives: | Maintain or improve habitat to support Grass Pickerel |
| | Maintain or increase resident minnow species diversity |
| | Maintain or increase resident sucker species |
| | Increase abundance of resident piscivorous species |
| | Maintain connectivity to Niagara River |
| Manangement Recommendations: | Improve wetland habitat in backwater estuary to River |
| | Improve riparian habitat in watershed |
| | Increase stormwater retention in watershed |

## Table 7 Species Presence and Relative Abundance Miller Creek

| COSE WIC | Common Name | Scientific Name | 2009 Nov 5 stns | 2003 Sep 3 stns | Repeat Station 2 | | | | | | ROM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2009 Nov | 2007 Oct | 2005 Jul | 2004 Jun | 2003 Sep | 1979 Aug | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | 0.7% | | | + |
| | Central Mudminnow | *Umbra limi* | 0.7% | 6.6% | <0.1% | | 43.1% | 7.7% | 3.0% | | |
| | White sucker | *Catostomus commersoni* | 0.2% | 11.1% | <0.1% | 10.3% | 2.1% | 19.9% | 10.0% | 0.7% | + |
| | Silver Redhorse | *Moxostoma anisurum* | | | | | 19.1% | | | | |
| | Golden Redhorse | *Moxostoma erythrurum* | | | | | | | | | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | 0.6% | | | | | | | |
| | Greater Redhorse | *Moxostoma valenciennesi* | | | | | | | | | + |
| | Redhorse sp | *Moxostoma* sp. | | | | | 2.1% | | | | |
| | Black Bullhead | *Ameiurus melas* | | | | | | 3.8% | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.2% | 5.0% | | 4.8% | 1.1% | 1.7% | 17.9% | | + |
| | Tadpole Madtom | *Noturus gyrinus* | 0.2% | 1.5% | | 14.7% | | 5.9% | 0.5% | | + |
| | Johnny Darter | *Etheostoma nigrum* | 0.3% | 0.2% | 0.1% | 0.7% | 2.7% | 0.3% | 0.5% | 0.1% | + |
| | Logperch | *Percina caprodes* | | | | | | | | | + |
| | Mottled Sculpin | *Cottus bairdi* | | | | | | | | | + |
| | Brook Stickleback | *Culaea inconstans* | <0.1% | | | | | | | | |
| | Brook Silverside | *Labidesthes sicculus* | 0.5% | | 0.5% | | | | | | |
| | River Chub | *Nocomis micropogon* | | | | | | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | <0.1% | 3.8% | | 0.7% | 0.5% | 17.5% | | 0.7% | + |
| | Emerald Shiner | *Notropis atherinoides* | 50.3% | | 79.0% | | 0.5% | 1.4% | | 0.1% | + |
| | Common Shiner | *Luxilus cornutus* | 2.1% | 0.7% | 2.0% | 3.7% | | | | 0.8% | + |
| | Spottail Shiner | *Notropis hudsonius* | 3.0% | | 3.8% | | | | | 1.2% | + |
| | Spotfin Shiner | *Notropis spiloterus* | | | | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 10.4% | 6.9% | 5.0% | | 11.2% | 1.7% | | 0.1% | + |
| | Fathead Minnow | *Pimephales promelas* | 0.1% | | | | 1.1% | | | 1.2% | + |
| | Creek Chub | *Semotilus atromaculatus* | 1.4% | | | | | 0.3% | | 0.1% | |
| | Striped Shiner | *Luxilus chrysocephalus* | 10.3% | | | | | | | | + |
| | Hornyhead Chub | *Nocomis biguttatus* | 0.4% | | | | | | | | |
| | Rock Bass | *Ambloplites rupestris* | 12.0% | 11.3% | 4.6% | 2.6% | 4.8% | 4.2% | 6.0% | | + |
| | Green Sunfish | *Lepomis cyanellus* | 3.2% | 2.4% | 1.3% | 19.9% | 7.4% | 10.1% | 10.0% | | |
| | Pumpkinseed | *Lepomis gibbosus* | <0.1% | 15.2% | | | 1.1% | 6.6% | 36.8% | 0.1% | + |
| | Bluegill | *Lepomis macrochirus* | 0.5% | 1.8% | | | | 4.9% | | | + |
| | YOY sunfish | *Lepomis* sp. | | | | 2.6% | | | | | |
| | Northern Pike | *Esox lucius* | | 0.2% | | | | 0.3% | 0.5% | | + |
| | Muskellunge | *Esox masquinongy* | | 0.3% | | | | | | | + |
| | Smallmouth Bass | *Micropterus dolomieui* | 0.7% | | | | | | | 0.1% | + |
| | Largemouth Bass | *Micropterus salmoides* | 1.8% | 5.1% | 1.4% | 7.8% | 1.1% | | 4.0% | 0.2% | + |
| | White Crappie | *Pomoxis annularis* | | 0.2% | | | | | | 42.3% | |
| | Black Crappie | *Pomoxis nigromaculatus* | | | | | | | | 39.5% | + |
| | Yellow Perch | *Perca flavescens* | 0.1% | 8.0% | | | | 11.5% | 9.5% | | |
| | Round Goby | *Neogobius melanostomus* | 0.1% | 2.5% | | | | | | | |
| | Alewife | *Alosa pseudoharengus* | | | | | | | | | + |
| | Gizzard shad | *Dorosoma cepedianum* | | 9.0% | | | | | | 12.5% | |
| | Banded Killifish | *Fundulus diaphanus* | 1.4% | 3.2% | 2.3% | 32.4% | | | 0.5% | | |
| | Goldfish | *Carassius auratus* | | 3.2% | | | 2.1% | | 0.5% | 0.5% | |
| | Common Carp | *Cyprinus carpio* | | 1.1% | | | | 1.0% | 0.5% | | |
| | *TOTAL* | 43 | 25 | 23 | 12 | 11 | 15 | 18 | 14 | 16 | 27 |
| | *#fish caught* | | 4017 | 940 | 2213 | 272 | 188 | 286 | 201 | 1646 | |

Legend for Table 7

| | | **COSEWIC Status** | |
|---|---|---|---|
| 🟩 | Native Minnow family | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | | |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | + | Denotes historic presence only |

## Bakers Creek – Upper Niagara River Tributary

Available residual summer habitat is approximately 500m and limits sampling in Bakers Creek to near the creek mouth (Figure 25). Sampling in 2003 included a second station at the mouth of the creek to show any influence of the creek/river interface. The station at the creek mouth included coarser river-type substrate with no vegetation, compared to the upstream station where a moderate abundance of submerged vegetation was present and substrate had a component of loose fines. The creek upstream of the sampling is described as a densely vegetated wetland creek. The upstream site was surveyed using bag seine in 1979 and repeated with the same methods and gear in 2003-05 and 2007.

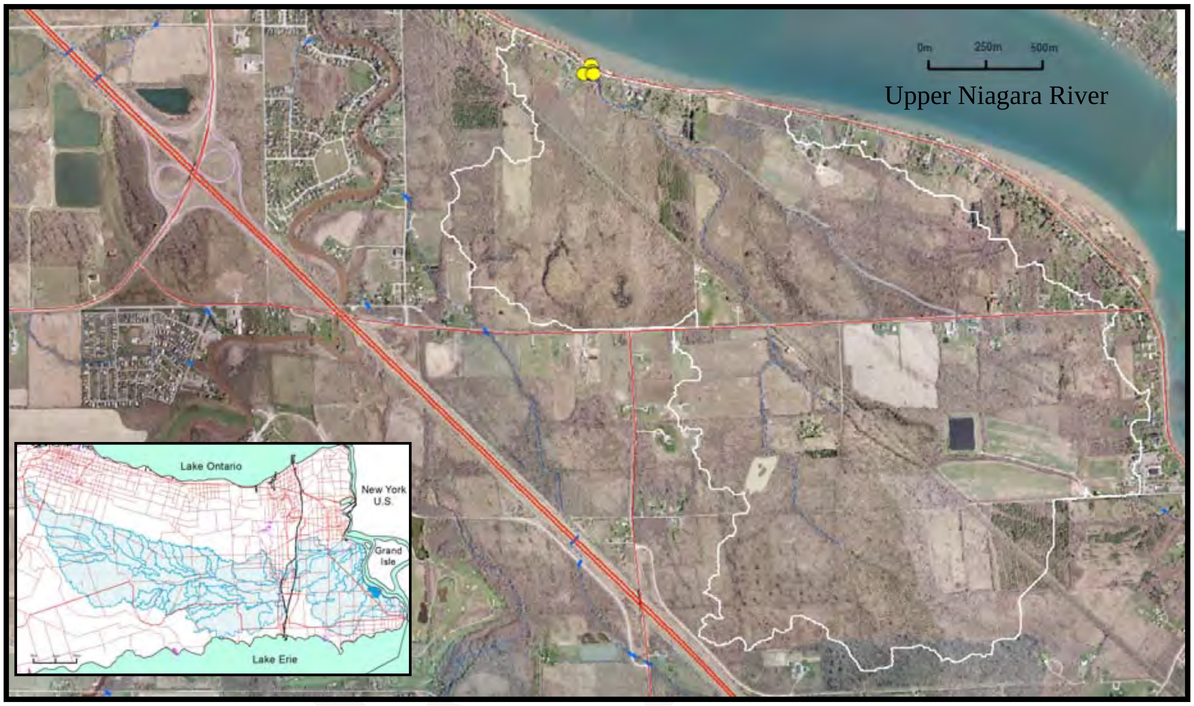

**Figure 25 Bakers Creek Sampling Location**

Survey results for all survey periods are presented in Table 8. Combining recent and historic sampling, 34 species are recorded from Bakers Creek including one Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 4 exotic species, round goby, goldfish, banded killifish and common carp. Historic species not found with recent surveys are greater redhorse, hornyhead chub, sand shiner and striped shiner. All species found in 1979 were captured again in recent sampling except white crappie. Recent collection of species not found in the 1979 survey include grass pickerel and central mudminnow, two species indicative of creeks with wetland conditions of heavier aquatic plant growth and a component of organic substrate. Sampling in 2003 to include the coarser substrate at the mouth of the creek collected lithophillic species YOY shorthead redhorse, Johnny darter and rainbow darter.

Though not found in 1979, there has been consistent occurrence of grass pickerel in recent sampling including both YOY and sexually mature individuals suggesting grass pickerel is a resident species. Baker’s Creek also provides spawning and rearing for a number of piscivorous species as indicated by collection of YOY longnose gar (2005), YOY largemouth bass every year and YOY northern pike (2005), however adults of these species were not found in the creek. Sampling also indicates use of Baker’s Creek for spawning by the sucker family with YOY shorthead redhorse (2003) and YOY white sucker (2007). Similar to other tributaries of the Upper Niagara River, Baker’s Creek is periodically inundated by schools of river minnows such as emerald shiner (2004) and common shiner (1979).

# Table 8 Species Presence and Relative Abundance Bakers Creek

| | | | Repeat Station 2 | | | | | 2 stns | |
|---|---|---|---|---|---|---|---|---|---|
| COWE WIC | Common Name | Scientific Name | Oct 2007 | Jul 2005 | Jul 2004 | Sep 2003 | Aug 1979 | Sep 2003 | ROM |
| | Longnose Gar | *Lepisosteus osseus* | | 2.2% | | | | | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 0.6% | 26.7% | 3.3% | 2.5% | | 3.3% | + |
| | Central Mudminnow | *Umbra limi* | 1.5% | | 3.3% | 2.9% | | 3.0% | + |
| | White sucker | *Catostomus commersoni* | 2.1% | | | 4.5% | 0.5% | 4.8% | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | | | | 0.4% | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | | | | | | | + |
| | Black Bullhead | *Ameiurus melas* | | | | 0.4% | | 0.5% | |
| | Brown Bullhead | *Ameiurus nebulosus* | 1.1% | | 1.7% | 4.9% | 0.1% | 4.1% | + |
| | Tadpole Madtom | *Noturus gyrinus* | 1.5% | | | 3.7% | 0.2% | 3.7% | + |
| | Rainbow Darter | *Etheostoma caeruleum* | | | | | | 0.6% | |
| | Johnny Darter | *Etheostoma nigrum* | | | | | | 1.2% | + |
| | Brook Silverside | *Labidesthes sicculus* | 0.2% | | | | | | |
| | Hornyhead Chub | *Nocomis biguttatus* | | | | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 0.2% | 13.3% | | | 0.1% | | + |
| | Emerald Shiner | *Notropis atherinoides* | | | 20.2% | | 0.1% | | + |
| | Common Shiner | *Luxilus cornutus* | 1.9% | | | 4.9% | 64.5% | 4.1% | + |
| | Spottail Shiner | *Notropis hudsonius* | | | | 1.2% | 5.6% | 5.6% | + |
| | Sand Shiner | *Notropis stramineus* | | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 27.5% | 2.2% | | 53.1% | 0.1% | 44.2% | + |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | | | | + |
| | Rock Bass | *Ambloplites rupestris* | 24.3% | | | 11.9% | 7.8% | 11.2% | + |
| | Green Sunfish | *Lepomis cyanellus* | 0.6% | 15.6% | 46.7% | 1.6% | | 2.0% | |
| | Pumpkinseed | *Lepomis gibbosus* | 5.0% | 13.3% | 13.3% | 2.1% | 1.6% | 1.7% | + |
| | Bluegill | *Lepomis macrochirus* | 3.4% | 13.3% | 8.3% | 0.4% | 0.6% | | |
| | YOY sunfish | *Lepomis* sp. | 7.9% | | | | | | |
| | Northern Pike | *Esox lucius* | | 2.2% | | | 3.0% | | |
| | Smallmouth Bass | *Micropterus dolomieui* | | | | | | | + |
| | Largemouth Bass | *Micropterus salmoides* | 11.4% | 8.9% | 1.7% | 0.4% | 0.7% | 0.3% | |
| | White Crappie | *Pomoxis annularis* | | | | | 3.7% | | + |
| | Black Crappie | *Pomoxis nigromaculatus* | 0.2% | | | | 9.6% | | + |
| | Yellow Perch | *Perca flavescens* | | | | 0.4% | | 0.5% | + |
| | Round Goby | *Neogobius melanostomus* | | | 1.7% | 0.4% | | 1.4% | |
| | Banded Killifish | *Fundulus diaphanus* | 10.3% | | | 4.5% | 1.3% | 6.9% | + |
| | Goldfish | *Carassius auratus* | 0.4% | 2.2% | | | 0.6% | | + |
| | Common Carp | *Cyprinus carpio* | 0.2% | | | | | | |
| | *#SPECIES* | *30* | 16 | 8 | 7 | 14 | 16 | 16 | |
| | *#fish caught* | | 535 | 45 | 60 | 81 | 1223 | 324 | |

Legend for Table 8

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | **COSEWIC Status** | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬛ | Sucker family | + | Denotes historic presence only |

**Baker Creek Summary**

| | |
|---|---|
| Summer Flow regime: | Intermitent flow, 0.5km of permanent residual summer habitat, ~ 0.42ha |
| | No known migration barriers |
| Historic Data: | 1979 MNR survey 1 station. ROM historical records |
| Restorative Work | No known restoration projects |
| Habitat | Mix of rubble and fines near the mouth, more loose fines upstream. Sparse to moderate instream vegetation. |
| Fish Community Objectives: | Maintain or improve habitat to support Grass Pickerel |
| | Maintain or increase resident minnow species diversity from 5 to 8 or greater |
| | Maintain or increase resident sucker species from 2 to 3 or greater |
| | Increase abundance of resident piscivorous species |
| | Maintain connectivity to Niagara River |
| Manangement Recommendations: | Improve wetland habitat in backwater estuary to Niagara River |
| | Improve riparian habitat in watershed |

### Black Creek and Beaver Creek – Upper Niagara River Tributaries

Black Creek has approximately 13.85km of residual summer length plus approximately 5.5km in Beaver Creek, a tributary to Black Creek. Both Black Creek and Beaver Creek are groundwater fed. Black Creek headwaters come from Willoughby Marsh and its name reflects the large component of organics in the creek bed. Beaver Creek receives input from the Crystal Beach moraine. Beaver Creek has been recognized as an important tributary for the Species-at-Risk grass pickerel and has been the subject of extensive sampling by Department of Fisheries and Oceans (data not presented here). Sampling in 2003, 2004 – 2005 and 2007 covered 3 stations in the mid reach of the Black Creek, originally sampled in 1979. A fourth station was sampled by boat electrofishing near the mouth in 2004, but the lower extent of the creek was otherwise not sampled due to the necessity of needing a large boat, which was generally unavailable. Sampling in 2005 also included a monthly survey of one of the mid reach stations every month from June through November (Figure 26).

Survey results for Black Creek are presented in Table 9 as relative abundance. Beaver Creek sampling is presented in Table 10. Thirty six species recorded from Black Creek include one Species at Risk, grass pickerel (COSEWIC – Special Concern) and 4 exotics: common carp, goldfish, gizzard shad and alewife. Four historic native species not captured in recent sampling are shorthead redhorse (lithophillic and turbidity intolerant), trout-perch, hornyhead chub (lentic, lithophillic and turbidity intolerant) and striped shiner (lentic). Rainbow darter, muskellunge, spottail shiner and alewife captured in 1979 were also not collected in recent sampling. YOY walleye escapees from a local hatchery was collected in Black Creek in 2003 and 2004 but not included in the dataset. Boat electrofishing at the mouth included collection of adult muskellunge, adult northern pike, adult grass pickerel, and adult and YOY largemouth bass. Sampling in the upper reaches of Beaver Creek collected adult and YOY brown bullhead, YOY northern pike, YOY largemouth bass and YOY white sucker, as well as schools of gizzard shad (2005), periodic banded killifish (2005) and occasional emerald shiner. Sunfishes include both black and white crappie and rock bass. Habitat data was not collected for most of the sampling but includes a description from 2007 as having a mix of rubble, gravel, silt and clay with minor components of silt and boulder. Water was turbid at the time of the 2007 surveys.

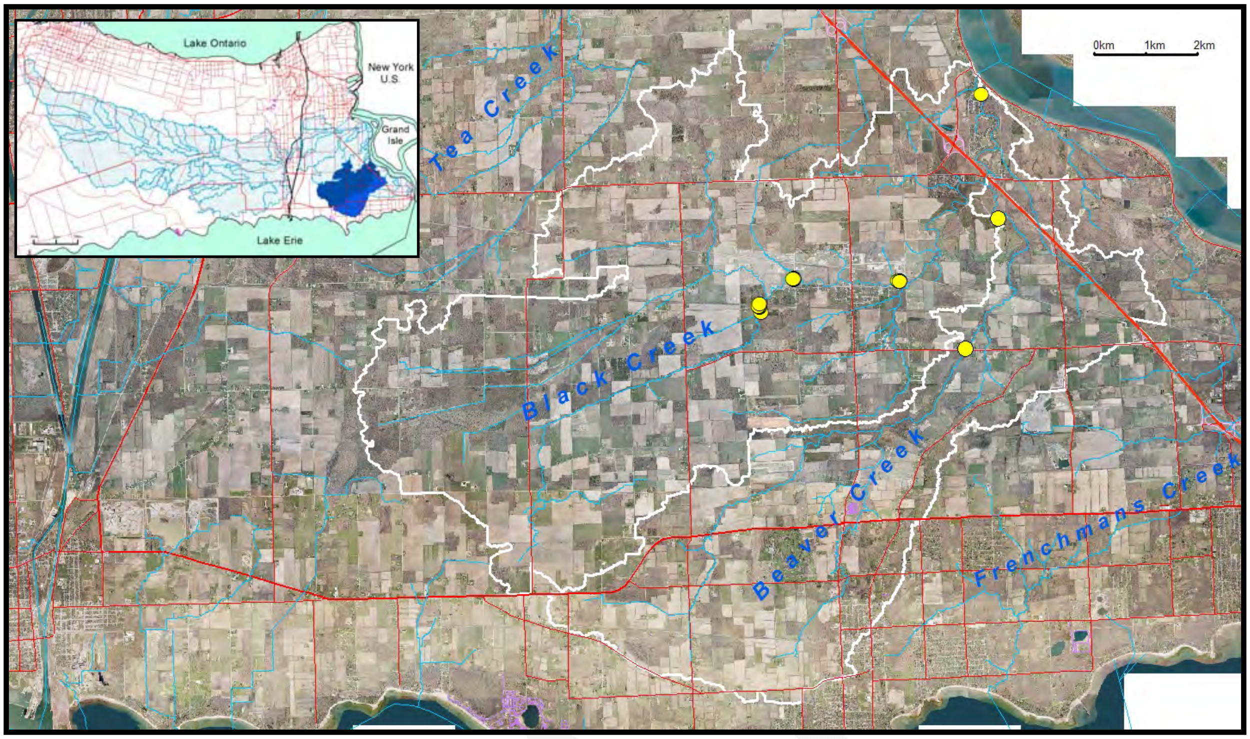

**Figure 26 Black and Beaver Creek Sampling Locations**

Beaver Creek runs along the edge of Willoughby Marsh and is generally described as having clear water. Abundant presence of grass pickerel, tadpole madtom, central mudminnow, largemouth bass and golden shiner reflects the extensive reach of heavily vegetated wetland creek habitat, relative to other upper Niagara River tributaries (similar to the top end of Bakers). Sampling collected adults and YOY of largemouth bass, brown bullhead and grass pickerel. Beaver creek is an important tributary for grass pickerel. This tributary supports the most abundant populations in the Niagara River watershed – 30 grass pickerel caught at one station and 69 caught at a second station in 2003. Piscivorous fish in Beaver Creek are adult northern pike, grass pickerel and bowfin. All species collected recently in Beaver Creek were also found in Black Creek. Five species collected historically were not collected again in the recent survey in Beaver Creek, but were found recently in Black Creek. Repeat sampling in Beaver creek shows more consistent results through the years compared to Frenchmans Creek and Miller Creek, likely due to there being 3 repeat stations (generally only 1 in the other Upper Niagara River tributaries). Consistency may also be due to Beaver Creek sampling done in the upper reaches, further from the influence of the Niagara River / creek interface, which has resulted in periodic large runs of some species in the other tributaries.

**Figure 27 Grass pickerel (*Esox americanus vermiculatus*)**

## Table 9 Species Presence and Relative Abundance Black Creek

| | | | Repeat stns 1,2,3 | | | | | All Stns | |
|---|---|---|---|---|---|---|---|---|---|
| COSEWIC | Common Name | Scientific Name | 2007 Oct/ Nov | 2005 Jul | 2004 Jun | 2003 Aug | 1979 Aug | 2003 Aug 4stns | ROM |
| | Bowfin | *Amia calva* | | | | 0.5% | | 0.4% | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 0.2% | 0.7% | 3.0% | 6.3% | | 5.7% | + |
| | Central Mudminnow | *Umbra limi* | 0.3% | 1.0% | 7.3% | 3.3% | 0.8% | 2.6% | |
| | White sucker | *Catostomus commersoni* | 0.7% | <0.1% | 0.4% | 3.% | 1.5% | 2.4% | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | | | | | + |
| | Black Bullhead | *Ameiurus melas* | | 0.1% | 2.1% | 0.3% | | 0.2% | + |
| | Yellow Bullhead | *Ameiurus natalis* | | | 0.2% | 0.3% | 0.1% | 0.4% | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.5% | 0.3% | 4.7% | 27.5% | 6.1% | 28.7% | + |
| | Tadpole Madtom | *Noturus gyrinus* | 0.6% | 0.1% | 0.2% | | 2.5% | | + |
| | Trout-perch | *Percopsis omiscomaycus* | | | | | | | + |
| | Rainbow Darter | *Etheostoma caeruleum* | | | | | <0.1% | | |
| | Johnny Darter | *Etheostoma nigrum* | 1.0% | 1.4% | 7.4% | 0.5% | 2.0% | 0.4% | + |
| | Brook Silverside | *Labidesthes sicculus* | 2.4% | | | | | | |
| | Hornyhead Chub | *Nocomis biguttatus* | | | | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 16.1% | 2.3% | 11.1% | 5.3% | 3.2% | 4.3% | + |
| | Emerald Shiner | *Notropis atherinoides* | | 0.0% | 4.7% | | 0.5% | | + |
| | Common Shiner | *Luxilus cornutus* | 0.1% | | | 3.5% | 3.9% | 3.2% | + |
| | Spottail Shiner | *Notropis hudsonius* | | | | | 6.1% | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 13.2% | 0.5% | 1.9% | | 4.9% | 0.4% | + |
| | Fathead Minnow | *Pimephales promelas* | | 0.0% | | | | | |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | | | | + |
| | Rock Bass | *Ambloplites rupestris* | | 0.0% | 0.2% | 0.3% | 0.8% | 0.4% | + |
| | Green Sunfish | *Lepomis cyanellus* | 8.5% | 1.3% | 13.4% | 2.5% | | 3.0% | |
| | Pumpkinseed | *Lepomis gibbosus* | 15.2% | 3.5% | 32.7% | 31.5% | 31.0% | 27.3% | + |
| | Bluegill | *Lepomis macrochirus* | 2.9% | 1.7% | 4.8% | 3.3% | 9.4% | 4.5% | |
| | Sunfish | *Lepomis* sp. | 20.1% | 0.1% | | | | | |
| | Northern Pike | *Esox lucius* | | 0.1% | 2.9% | 1.8% | 0.6% | 1.4% | + |
| | Muskellunge | *Esox masquinongy* | | | | | <0.1% | | |
| | Smallmouth Bass | *Micropterus dolomieui* | | <0.1% | | | | | |
| | Largemouth Bass | *Micropterus salmoides* | 5.6% | 0.1% | | 0.8% | <0.1% | 0.6% | |
| | White Crappie | *Pomoxis annularis* | 5.5% | 3.1% | | 6.5% | 12.4% | 7.9% | + |
| | Black Crappie | *Pomoxis nigromaculatus* | 2.1% | 0.7% | 0.7% | | 3.8% | | + |
| | Yellow Perch | *Perca flavescens* | 0.3% | 0.2% | 1.6% | 0.5% | 1.6% | 0.4% | + |
| | Alewife | *Alosa pseudoharengus* | | | | | 0.1% | | |
| | Gizzard Shad | *Dorosoma cepedianum* | 4.0% | 82.6% | | | 6.0% | 0.6% | + |
| | Goldfish | *Carassius auratus* | 0.1% | | | | 2.4% | | |
| | Common Carp | *Cyprinus carpio* | 0.6% | <0.1% | 0.7% | 2.8% | 0.1% | 5.1% | + |
| | *# SPECIES* | *37* | 21 | 24 | 19 | 19 | 25 | 21 | 23 |
| | *#fish caught* | | 871 | 2717 | 430 | 400 | 2739 | 494 | |

Legend for Table 33

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | **COSEWIC Status** | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ▨ | Sucker family | + | Denotes historic presence only |

**Table 10 Species Presence and Relative Abundance Beaver Creek (Fort Erie)**

| COSEWIC | Common Name | Scientific Name | 2003 Aug 2stns | ROM |
|---|---|---|---|---|
| | Bowfin | *Amia calva* | 0.1% | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 12.5% | + |
| | Central Mudminnow | *Umbra limi* | 0.2% | + |
| | White sucker | *Catostomus commersoni* | 1.0% | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 3.2% | |
| | Black Bullhead | *Ameiurus melas* | | + |
| | Tadpole Madtom | *Noturus gyrinus* | 2.5% | + |
| | Johnny Darter | *Etheostoma nigrum* | 0.4% | |
| | Channel Catfish | *Ictalurus punctatus* | | + |
| | Madtom Sp. | *Noturus* sp. | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 40.4% | + |
| | Rock Bass | *Ambloplites rupestris* | 1.1% | |
| | Green Sunfish | *Lepomis cyanellus* | 1.0% | |
| | Pumpkinseed | *Lepomis gibbosus* | 30.9% | + |
| | Muskellunge | *Esox masquinongy* | | + |
| | Northern Pike | *Esox lucius* | 0.9% | |
| | Largemouth Bass | *Micropterus salmoides* | 4.7% | + |
| | Smallmouth Bass | *Micropterus dolomieui* | | + |
| | Yellow Perch | *Perca flavescens* | 1.0% | + |
| | Common Carp | *Cyprinus carpio* | 0.1% | |
| | # SPECIES | *20* | 15 | 13 |
| | #fish caught | | 807 | |

Legend for Table 10

| | | COSEWIC Status | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | presence |
| ⬛ | Sucker family | + | Historic presence only |

## *Black and Beaver Creek Summary*

| | |
|---|---|
| Summer Flow regime: | 19.35km of permanent residual summer habitat including Beaver Creek tributary, ~ 13.26ha<br>No known migration barriers |
| Historic Data: | 1979 MNR survey 3 stations. ROM historical records |
| Restorative Work | No known restoration projects |
| Habitat | Mix of rubble and loose fines throughout. Sparse to moderate instream vegetation and emergent wetland edge. |
| Fish Community Objectives: | Maintain or improve habitat to support Grass Pickerel<br>Increase resident minnow species diversity<br>Increase resident sucker species diversity<br>Increase abundance of resident piscivorous species<br>Maintain connectivity to Niagara River<br>Increase abundance of resident intolerant fish species to >50% |
| Manangement Recommendations: | Improve wetland edge habitat along creek<br>Increase riparian habitat<br>Improve instream habitat quality and diversity |

## Boyers Creek – Upper Niagara River Tributary

Boyers Creek has approximately 1.7km of residual summer length, above which the creek is dry except for a large off line pond that becomes flooded during spring high water conditions. Sampling in 2003 covered 3 creek stations, the most downstream of which was a repeat of the station sampled in 1979. Recent repeat sampling was done at the 1979 sampling location and a second station upstream (Figure 28). The off line pond was surveyed in 2003 as part of a presence / absence study and contained commonly found Niagara River watershed species, as well as some of which are not found in summer surveys of Boyers Creek including larger pike (total lengths 711mm and 654mm), freshwater drum, gizzard shad and yellow bullhead. These species indicate use of the tributary by Niagara River fish during periods of high flow when the pond is connected by surface water. Data from the pond survey is not included in the sampling analysis. Records of tesselated darter from the upstream station in 2005 were not verified, and therefore added to the total of Johnny darters.

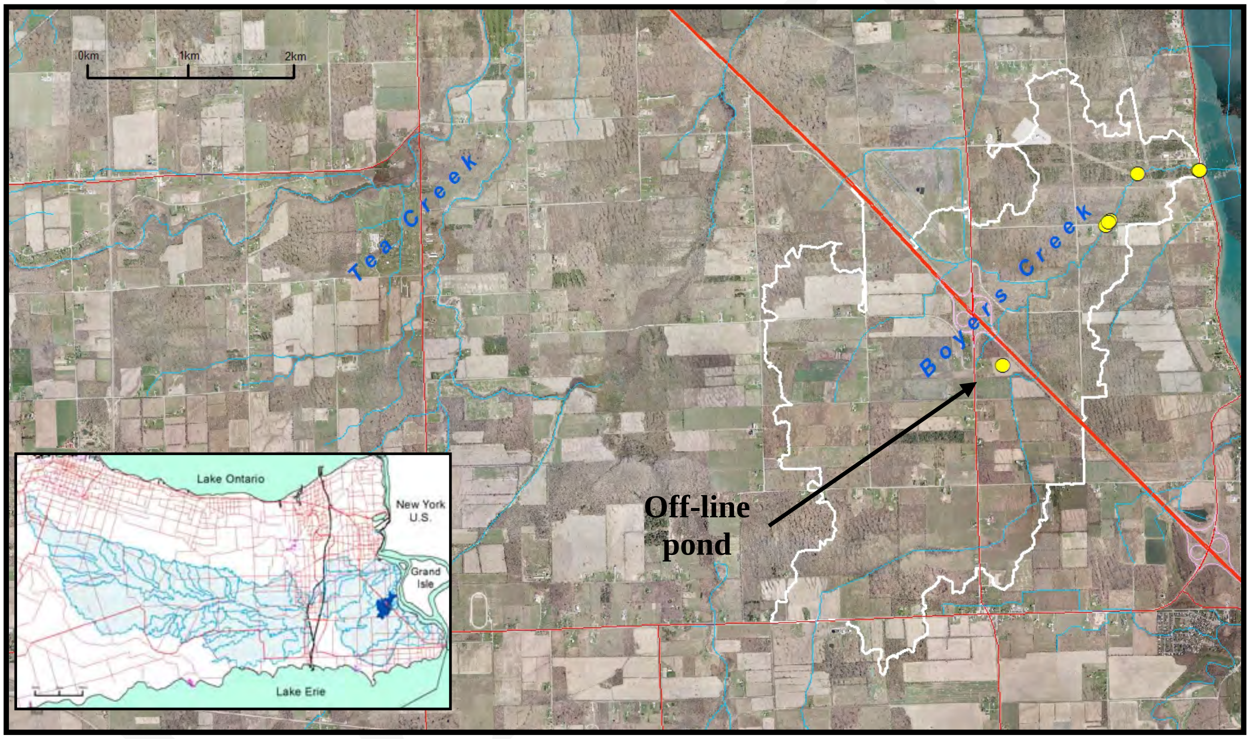

**Figure 28 Boyers Creek Sampling Locations**

Survey results for all survey periods in Boyers Creek are presented in Table 11. The 33 species recorded from Boyer Creek include one Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 4 exotics: common carp, goldfish, round goby and alewife. Four historic native species not captured in recent sampling are greater redhorse, logperch, hornyhead chub, striped shiner and muskellunge. All species caught in the 1979 sampling were recaptured with recent sampling. Longear sunfish caught in 2005 is unique to this tributary, and has not been collected from any other part of the Upper Niagara River watershed. Similar to other Upper Niagara River tributaries Boyer's creek provides spawning and rearing habitat for species that are not creek resident as adults, as evident by records of YOY northern pike, YOY largemouth bass, and periodic YOY white sucker and YOY shorthead redhorse. YOY largemouth bass make up the largest relative abundance in 2005 but are present in all sampling periods. Larger, immature, piscivorous-sized northern pike are collected from the station near the mouth, but otherwise piscivores are represented by grass pickerel found both near the mouth and at the upstream repeat station. Boyers Creek has higher abundances of sunfish, rather than minnows near the mouth reflecting a more open, ponded creek form compared to the upstream station that is outside of the influence of daily river water level fluctuation. The upstream station is comprised of higher relative abundances of central mudminnows and Johnny darters. No suckers or cyprinids were collected in the August 2005 survey. The dry conditions in 2007 are reflected in comparatively low abundance and species diversity, and the lack of water appears to have ridden that station of any of the larger fish (sunfishes, grass pickerel, pike and bullheads). Boyers's Creek sees periodic runs of emerald shiners (June 2004) and spottail shiners (July 2003) from the river.

**Table 11 Species Presence and Relative Abundance Boyer's Creek**

| COSEWIC | Common Name | Scientific Name | Repeat Stn 3 |  |  |  | Repeat Stn 1 |  |  |  | 2003 Jul-Oct 4stns | ROM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 2007 Oct | 2005 Jul | 2004 Jun | 2003 Jul | 2005 Aug | 2005 Jul | 2003 Oct | 1979 |  |  |
| SC | Grass Pickerel | *Esox americanus vermiculatus* |  |  | 0.6% | 5.0% |  |  |  |  | 1.9% |  |
|  | Central Mudminnow | *Umbra limi* | 4.5% | 23.1% | 29.3% | 39.7% | 1.0% |  |  |  | 13.4% |  |
|  | White sucker | *Catostomus commersoni* | 0.6% | 1.3% | 1.7% | 3.5% |  |  | 4.4% | 6.9% | 3.6% |  |
|  | Shorthead Redhorse | *Moxostoma macrolepidotum* |  | 1.3% |  |  |  | 0.5% |  |  |  | + |
|  | Greater Redhorse | *Moxostoma valenciennesi* |  |  |  |  |  |  |  |  |  | + |
|  | Black Bullhead | *Ameiurus melas* |  |  | 5.9% |  |  |  |  |  |  |  |
|  | Brown Bullhead | *Ameiurus nebulosus* |  | 0.4% | 18.9% | 16.1% |  |  |  | 11.9% | 6.1% |  |
|  | Tadpole Madtom | *Noturus gyrinus* | 1.1% | 0.9% | 24.5% | 11.1% | 1.0% | 1.9% |  | 22.8% | 3.7% | + |
|  | Johnny Darter | *Etheostoma nigrum* | 68.8% | 21.0% | 0.8% | 3.5% |  | 0.5% |  | 5.9% | 1.2% | + |
|  | Logperch | *Percina caprodes* |  |  |  |  |  |  |  |  |  | + |
|  | Hornyhead Chub | *Nocomis biguttatus* |  |  |  |  |  |  |  |  |  | + |
|  | Golden Shiner | *Notemigonus crysoleucas* |  | 7.4% | 0.6% | 0.5% |  | 2.4% | 13.8% | 3.0% | 12.4% | + |
|  | Emerald Shiner | *Notropis atherinoides* |  |  | 0.6% |  |  |  |  |  |  | + |
|  | Common Shiner | *Luxilus cornutus* |  |  |  |  |  |  | 10.0% | 1.0% | 5.4% |  |
|  | Spottail Shiner | *Notropis hudsonius* |  |  |  | 1.0% |  |  |  |  | 0.3% | + |
|  | Bluntnose Minnow | *Pimephales notatus* | 11.9% | 1.7% |  |  |  | 5.3% | 8.8% | 4.0% | 4.7% | + |
|  | Creek Chub | *Semotilus atromaculatus* |  |  | 0.3% |  |  |  |  |  |  |  |
|  | Striped Shiner | *Luxilus chrysocephalus* |  |  |  |  |  |  |  |  |  | + |
|  | Rock Bass | *Ambloplites rupestris* |  | 0.4% | 3.7% |  | 27.8% | 14.6% | 10.0% | 5.0% | 5.4% | + |
|  | Green Sunfish | *Lepomis cyanellus* |  | 6.1% | 7.6% | 9.0% | 1.0% |  |  |  | 3.1% |  |
|  | Pumpkinseed | *Lepomis gibbosus* |  |  | 2.8% | 7.5% | 9.3% | 22.8% | 25.0% | 16.8% | 21.0% | + |
|  | Bluegill | *Lepomis macrochirus* |  | 1.3% |  | 0.5% | 1.0% | 6.8% |  |  | 0.2% |  |
|  | Longear Sunfish | *Lepomis megalotis* |  |  |  |  |  | 0.5% |  |  |  |  |
|  | Northern Pike | *Esox lucius* |  |  | 0.8% | 1.0% | 1.0% |  | 2.5% | 5.0% | 1.7% | + |
|  | Muskellunge | *Esox masquinongy* |  |  |  |  |  |  |  |  |  | + |
|  | Largemouth Bass | *Micropterus salmoides* | 1.7% | 17.4% | 0.8% | 1.5% | 47.4% | 37.4% | 6.3% | 12.9% | 3.9% |  |
|  | White Crappie | *Pomoxis annularis* |  |  |  |  | 1.0% |  | 3.8% |  | 3.4% | + |
|  | Black Crappie | *Pomoxis nigromaculatus* |  |  |  |  |  |  | 15.6% |  | 8.5% | + |
|  | Yellow Perch | *Perca flavescens* |  |  |  |  | 7.2% | 6.8% |  | 5.0% | 0.2% | + |
|  | Round Goby | *Neogobius melanostomus* |  |  |  |  | 1.0% |  |  |  |  |  |
|  | Alewife | *Alosa pseudoharengus* |  |  |  |  |  | 0.5% |  |  |  |  |
|  | Goldfish | *Carassius auratus* |  | 17.5% | 1.1% |  |  |  |  |  |  |  |
|  | Common Carp | *Cyprinus carpio* |  |  |  |  | 1.0% |  |  |  |  |  |
|  | *TOTAL* | *33* | 6 | 13 | 16 | 13 | 12 | 12 | 10 | 12 | 19 | 18 |
|  | *#fish caught* |  | 176 | 203 | 355 | 199 | 98 | 206 | 160 | 101 | 491 |  |

Legend for Table 11

|  |  | COSEWIC Status |  |
|---|---|---|---|
| 🟩 | Native Minnow family |  |  |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish |  |  |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ▨ | Sucker family | + | Denotes historic presence only |

**Boyers Creek Summary**

| | |
|---|---|
| Summer Flow regime: | Intermittent flow, 1.7km of permanent residual summer habitat, ~ 1.5ha |
| | No known migration barriers |
| Historic Data: | 1979 MNR survey 1 station. ROM historical records |
| Restorative Work | No known restoration projects |
| Habitat | Mix of rubble gravel and loose fines throughout. Instream and vegetation cover is moderate throughout with *Vallisneria* ap. near the mouth changing to a mix of *Elodea* sp., coontail, and *Potomageton* sp. upstream. |
| Fish Community Objectives: | Increase resident minnow species diversity |
| | Increase resident sucker species diversity |
| | Increase abundance of resident piscivorous species |
| Manangement Recommendations: | Maintain connectivity to Niagara River |
| | Improve wetland habitat in backwater estuary to Niagara River |
| | Improve riparian habitat in watershed |
| | Improve instream habitat quality |

## Usshers Creek – Upper Niagara River Tributary

The lower part of Usshers Creek runs through Legends on the Niagara golf course. In 2001, through a management agreement between Niagara Parks Commission, MNR and Department of Fisheries and Oceans, the lower portion of Usshers Creek started to receive a small amount of permanent summer flow augmentation from the Niagara River. Usshers Creek has approximately 3.96km of residual summer habitat. Sampling in 2003 included five stations covering various habitat types around the creek mouth and 2 stations upstream (Figure 29). Two of those stations, one near the mouth and one in the mid reaches were sampled in 1979 and in 1999. Repeat sampling in 2004, 2005 and 2007 covered the two 1979 stations as well as two more of the stations sampled near the creek mouth in 2003 that were ~50m and ~100m upstream of the first station. In 2009, 5 stations in the headwaters of the creek were sampled.

Survey results for all survey periods are presented in (Table 12) as relative abundance for both the comprehensive sampling of 2003 and 2009 and the repeat station sampling. Only the1999 data is available as a historic comparison[6]. Because the lower 3 stations are so close together, each representing the creek mouth, they have been presented interchangeably as the mouth station for comparison to the 1999 sampling.

The 41 species recorded from Usshers Creek include one Species at Risk, grass pickerel (COSEWIC – Special Concern) and 5 exotics: round goby, rainbow smelt (historically), banded killifish, common carp and goldfish. Eight historic native species not captured in recent sampling are quillback carpsucker, greater redhorse, trout-perch, fantail darter, hornyhead chub, spotfin shiner, sand shiner and striped shiner.

Sampling at the mouth includes lithophillic species: smallmouth bass, round goby and Johnny darter, as well as schools of the river species emerald shiner, spottail shiner, common shiner bluntnose minnow, and the occasional freshwater drum. A run of emerald shiners in 2003 resulted in hundreds seen at the station

---

[6] The 1979 data is available only as a summary of N/ha and kg/ha for each species

but too small for the sampling equipment and therefore not recorded. Use of Ussher's Creek for spawning and rearing are indicated by the presence of juvenile muskellunge and northern pike, schools of YOY white sucker and occasional schools of shorthead redhorse. Grass pickerel is consistently found at stations near the mouth. Habitat details are generally absent but include one description of substrate dominated by a mix of rubble, gravel, sand and silt with approximately 30% bed coverage by aquatic vegetation.

Sampling from the mid reaches of Ussher's Creek are approximatelty 2km upstream from the mouth within the golf course setting and include central mudminnow, black and brown bullhead, grass pickerel, YOY white sucker, YOY largemouth bass, golden shiner and sunfishes.

Sampling in 2009 was conducted to sample stations in the headwaters closer to Willoughby Marsh. The creek at these locations is classified as the Union Marsh Drain. The stations are described as having 100% muck bottom with abundant in-water woody debris supporting golden shiner, central mudminnow, YOY largemouth bass, grass pickerel and sunfishes.

Future sampling may result in an increase in abundance or extent of lentic species and possibly lithophillic species given the flow augmentation with Niagara River water.

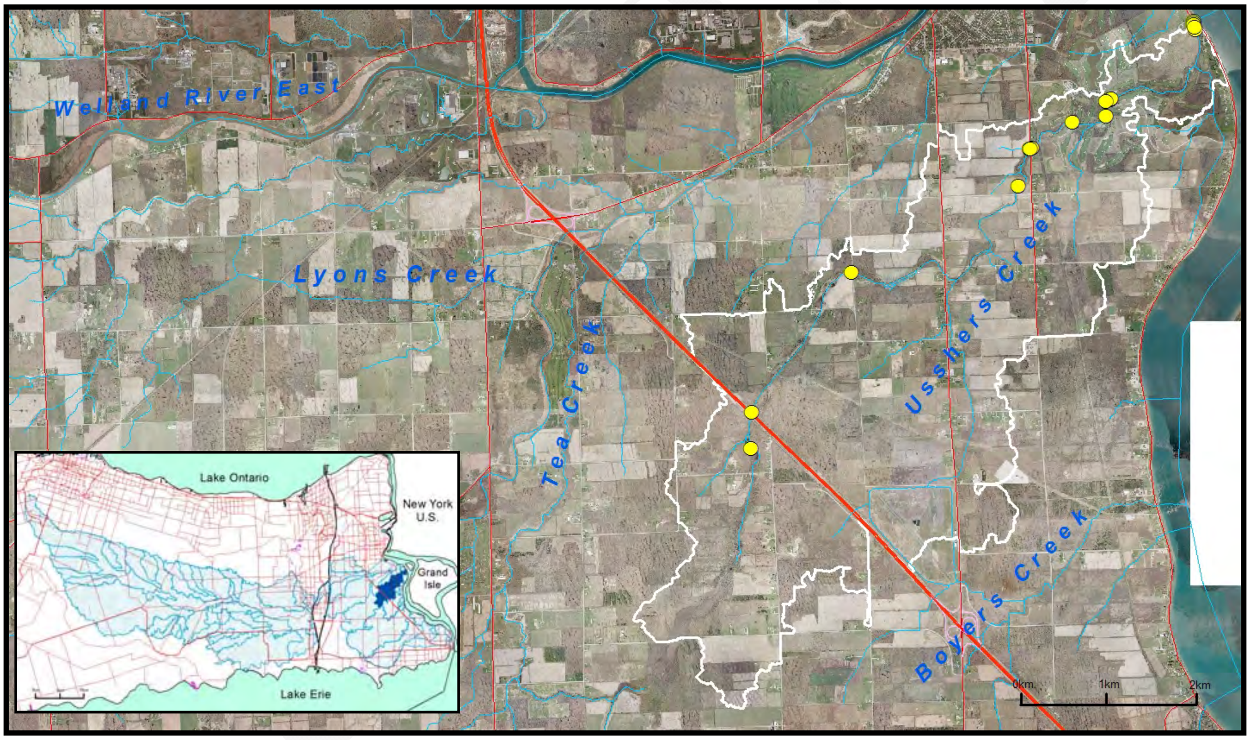

Figure 29 Usshers Creek Sampling Locations

## Table 12 Species Presence and Relative Abundance Usshers Creek

| COSEWIC | Common Name | Scientific Name | 2009 Aug 5stns | Repeat 2 stns<br>2005 Jul | 2004 Jul/Sep | 2003 Sep /Oct | 1999 Oct | 2003 Sep/Oct 5stns | ROM |
|---|---|---|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 1.5% | 2.4% | 4.9% | 1.1% | 1.0% | 2.6% | + |
|  | Central Mudminnow | *Umbra limi* | 21.2% | 0.7% | 4.6% | 21.0% | 1.3% | 10.1% | + |
|  | Quillback Carpsucker | *Carpiodes cyprinus* |  |  |  |  |  |  | + |
|  | White sucker | *Catostomus commersoni* |  | 3.8% | 5.6% | 3.3% | 0.3% | 4.7% | + |
|  | Shorthead Redhorse | *Moxostoma macrolepidotum* |  |  |  |  |  | 3.9% | + |
|  | Greater Redhorse | *Moxostoma valenciennesi* |  |  |  |  |  |  | + |
|  | Black Bullhead | *Ameiurus melas* |  |  |  | 6.3% |  | 2.4% |  |
|  | Brown Bullhead | *Ameiurus nebulosus* | 0.7% | 1.6% | 0.7% | 21.0% | 6.1% | 7.5% | + |
|  | Tadpole Madtom | *Noturus gyrinus* |  |  | 1.8% | 0.4% | 0.3% | 0.3% | + |
|  | Trout-perch | *Percopsis omiscomaycus* |  |  |  |  |  |  | + |
|  | Rainbow Darter | *Etheostoma caeruleum* |  |  |  |  | 0.3% |  | + |
|  | Fantail Darter | *Etheostoma flabellare* |  |  |  |  |  |  | + |
|  | Johnny Darter | *Etheostoma nigrum* |  | 3.1% |  | 4.1% | 1.6% | 2.1% | + |
|  | Freshwater Drum | *Aplodinotus grunniens* |  |  |  | 0.7% |  | 0.3% |  |
|  | Hornyhead Chub | *Nocomis biguttatus* |  |  |  |  |  |  | + |
|  | Golden Shiner | *Notemigonus crysoleucas* | 33.3% | 7.6% | 13.0% | 0.7% |  | 2.6% | + |
|  | Emerald Shiner | *Notropis atherinoides* |  |  | 0.4% | 1.8% | 37.6% | 4.2% | + |
|  | Common Shiner | *Luxilus cornutus* |  |  |  |  |  | 8.9% | + |
|  | Spottail Shiner | *Notropis hudsonius* |  |  |  | 3.0% |  | 1.0% | + |
|  | Spotfin Shiner | *Notropis spiloterus* |  |  |  |  |  |  | + |
|  | Sand Shiner | *Notropis stramineus* |  |  |  |  |  |  | + |
|  | Bluntnose Minnow | *Pimephales notatus* |  | 48.9% |  |  |  | 5.4% | + |
|  | Fathead Minnow | *Pimephales promelas* |  |  |  |  |  |  | + |
|  | Creek Chub | *Semotilus atromaculatus* |  |  |  |  | 0.3% |  |  |
|  | Striped Shiner | *Luxilus chrysocephalus* |  |  |  |  |  |  | + |
|  | Unidentified Minnow |  |  |  |  |  | 43.6% |  |  |
|  | Rock Bass | *Ambloplites rupestris* |  | 1.3% | 4.9% | 0.7% | 3.8% | 10.7% | + |
|  | Green Sunfish | *Lepomis cyanellus* | 21.2% | 0.5% | 7.0% | 3.0% |  | 6.4% |  |
|  | Pumpkinseed | *Lepomis gibbosus* | 5.6% | 6.7% | 9.5% | 2.6% | 0.6% | 5.4% | + |
|  | Bluegill | *Lepomis macrochirus* |  | 0.9% | 21.1% | 0.4% |  | 2.1% |  |
|  | sunfish | *Lepomis* sp. |  |  |  |  | 0.3% |  |  |
|  | Northern Pike | *Esox lucius* |  |  |  |  |  | 0.5% |  |
|  | Muskellunge | *Esox masquinongy* |  |  |  |  |  | 0.4% | + |
|  | Smallmouth Bass | *Micropterus dolomieui* |  |  | 0.4% |  | 1.3% |  | + |
|  | Largemouth Bass | *Micropterus salmoides* | 8.2% | 21.9% | 23.9% | 3.3% |  | 4.4% |  |
|  | White Crappie | *Pomoxis annularis* | 5.7% |  |  |  |  |  | + |
|  | Black Crappie | *Pomoxis nigromaculatus* |  |  | 0.7% |  |  | 0.3% |  |
|  | Yellow Perch | *Perca flavescens* |  | 0.2% | 1.8% |  |  | 0.7% | + |
|  | Round Goby | *Neogobius melanostomus* |  |  |  | 26.2% |  | 12.4% |  |
|  | Rainbow Smelt | *Osmerus mordax* |  |  |  |  |  |  | + |
|  | Banded Killifish | *Fundulus diaphanus* |  |  |  |  | 1.0% | 0.1% | + |
|  | Goldfish | *Carassius auratus* |  |  |  |  | 0.3% | 0.4% |  |
|  | Common Carp | *Cyprinus carpio* | 2.6% | 0.2% |  | 0.4% | 0.3% | 0.3% |  |
|  | #SPECIES | *41* | 9 | 15 | 15 | 18 | 15 | 27 |  |
|  | #fish caught |  | 267 | 552 | 285 | 271 | 314 | 603 |  |

Legend for Table 12

|  |  | COSEWIC Status |  |
|---|---|---|---|
| 🟩 | Native Minnow family |  |  |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish |  |  |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | + | Denotes historic presence only |

**Usshers Creek Summary**

| | |
|---|---|
| Summer Flow regime: | Artificial permanent flow in lower portion, 3.96km of permanent residual summer habitat, ~ 4.4ha<br>No known migration barriers |
| Historic Data: | 1979 MNR survey 1 station, 1999 4 stns . ROM historical records |
| Restorative Work | Flow augmentation in 2001 |
| Habitat | Mix of rubble and boulder over clay near the creek mouth, dominance of clay and loose fines upstream. Instream cover and vegetation increases upstream compared to stations near the mouth. |
| Fish Community Objectives: | Increase resident minnow species diversity<br>Increase resident sucker species diversity<br>Increase abundance of resident piscivorous species |
| Manangement Recommendations: | Maintain connectivity to Niagara River<br>Improve wetland habitat in backwater estuary to Niagara River<br>Improve riparian habitat in watershed<br>Improve instream habitat quality |

## 4.3 CHIPPAWA CHANNEL

The Chippawa Channel is the last 7km of what was the original mouth of the Welland River. The Channel flows from the Niagara River “upstream” (westward) to the confluence of the Chippawa-Queenston Power Canal and what is now the mouth of the Welland River (discussed in section 3.2.1). The confluence of the Power Canal, the Welland River East and the Chippawa Channel is referred to in this report as Triangle Island. Four stations were sampled by boat electrofishing in September 2004 and represent the first fish community study in this ARA (Figure 30). A station at the inlet of the Power Canal sampled in September of 2009 is included in the results as it covers the confluence of the Power Canal with the Chippawa Channel. Repeat sampling in September 2008 covered two previously assessed stations.

Sampling rate in 2004 was 286m/km, higher than the mean 226m/km for all ARAs sampled by boat electrofishing. Considering the uniformity of the channel from past dredging works, the distance from shore was consistent for each station. Shoreline substrate was rock rip rap. Some *Vallisneria* sp. was present along the littoral zone edge just beyond the extent of rip rap. Water clarity while sampling was excellent for all stations. The station closest to the Niagara River had the fastest flows which may have lowered our catch results in that station. Mean catch per unit effort in 2004 was (CPUE) 346 fish/1000 ES +- 423 (95%CL) indicating a high overall variance between stations. Sampling effort should be greater in this channel to reduce variance and increase confidence in the CPUE value or further subdivide this section into more uniform habitat types related to flow.

Table 13 lists 44 species recorded from this ARA and includes a lake sturgeon siting from US diving studies from 1994 – 1997 (See Appendix A for a map of siting locations). Generic redhorse species collected in 2004 were YOY redhorses too small to further speciate. Collections include 9 exotics. All species collected were also recorded for the Upper Niagara River.

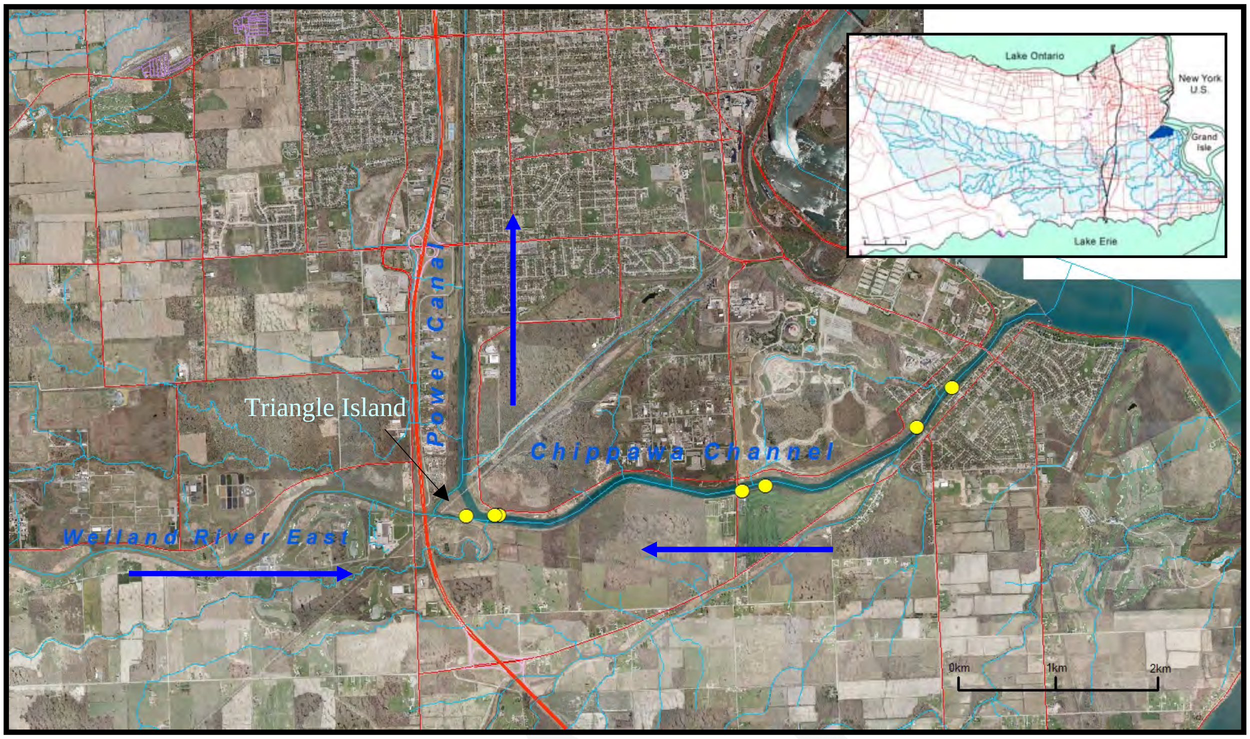

**Figure 30 Chippawa Channel Sampling Locations. Flow direction indicated by arrows.**

Niagara River species not collected in Chippawa Channel were northern hog sucker, golden sucker, black and brown bullheads, hornyhead chub, striped shiner and walleye. In addition to this list, northern brook lamprey was found in the Chippawa Channel by divers and submitted to MNR for verification in the early 1990's. This species is a non parasitic lamprey normally found in good water quality areas. The find is significant because northern brook lamprey is a species at risk (COSEWIC - Special Concern). It burrows in the substrate and is not likely to be caught with electrofishing techniques. Adult samples are rare to collect because they are small (approx. 150mm TL) and die after spawning (Scott and Crossman, 1973).

Six piscivores are recorded in the Chippawa Channel including adult bowfin and rainbow trout. Records of largemouth bass include a few large adults and juveniles, but mostly YOY. All pike collected were juveniles. Smallmouth bass include a few adults but mostly YOY. As well, a YOY muskellunge was captured in a *Vallisneria sp*. weedbed situated at the confluence of the Welland River East, Grassy Brook and the Chippawa Channel, suggesting spring spawning movement of adult muskellunge from the Upper Niagara River through the Chippawa channel to this confluence. Walleye are noticeably absent. Three species of sucker spawn in this section of the river as evident by collections of YOY and juvenile white sucker, YOY greater redhorse and both adults and YOY shorthead redhorse. In addition to the suckers and piscivores, schools of migrant minnows demonstrate the open connection with the Niagara River. Species such as spottail shiner, emerald shiner, gizzard shad, rainbow smelt and common shiner are common in the Chippawa Channel and their abundances show variation attributed to seasonal movement, compared to relatively stable and small occurrences of resident species such as creek chub and fathead minnow.

## Table 13 Fish Species Presence and Relative Abundance Chippawa Channel

| COSEWIC | Common Name | Scientific Name | 2008 Oct 2stns | 2004 Oct 4stns | 2004 Sep 1stn | MNR or NYDEC record | Tribs 2003-2009 |
|---|---|---|---|---|---|---|---|
| THR | Lake Sturgeon | *Acipenser fulvenscens* | | | | + | |
| | Bowfin | *Amia calva* | | 0.1% | + | | + |
| SC | Northern Brook Lamprey | *Ichthyomyzon fossor* | | | | + | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | + |
| | Central Mudminnow | *Umbra limi* | | | | | + |
| | White sucker | *Catostomus commersoni* | 13.7% | 4.0% | + | | + |
| END | Lake Chubsucker | *Erimyon sucetta* | | | | | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | + | | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | 1.2% | 0.1% | | | + |
| | Redhorse sp | *Moxostoma sp.* | | 0.7% | + | | |
| | Trout-perch | *Percopsis omiscomaycus* | | 0.1% | | | + |
| | Rainbow Darter | *Etheostoma caeruleum* | | 0.4% | | | + |
| | Johnny Darter | *Etheostoma nigrum* | 0.6% | 2.2% | + | | + |
| | Logperch | *Percina caprodes* | | 0.4% | | | + |
| | Freshwater Drum | *Aplodinotus grunniens* | | | | | + |
| | Brook Silverside | *Labidesthes sicculus* | 3.1% | 0.2% | | | |
| | Brook Stickleback | *Culaea inconstans* | | | | | + |
| | Mottled sculpin | *Cottus bairdi* | | 0.2% | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | | 2.5% | + | | + |
| | Emerald Shiner | *Notropis atherinoides* | 8.1% | 16.5% | + | | + |
| | Common Shiner | *Luxilus cornutus* | | 7.7% | | | + |
| | Spottail Shiner | *Notropis hudsonius* | 33.5% | 20.5% | + | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 13.7% | 14.5% | + | | + |
| | Fathead Minnow | *Pimephales promelas* | | 1.2% | | | + |
| | Creek Chub | *Semotilus atromaculatus* | | 0.7% | | | + |
| | Minnow sp | *Cyprinidae* | | 0.1% | | | |
| | Rock Bass | *Ambloplites rupestris* | 2.5% | 7.7% | + | | + |
| | Green Sunfish | *Lepomis cyanellus* | | 1.0% | + | | + |
| | Pumpkinseed | *Lepomis gibbosus* | | 0.1% | + | | + |
| | Bluegill | *Lepomis macrochirus* | 0.6% | | + | | + |
| | Northern Pike | *Esox lucius* | | 0.1% | + | | + |
| | Muskellunge | *Esox masquinongy* | | | | | + |
| | Smallmouth Bass | *Micropterus dolomieui* | 1.2% | 0.9% | | | + |
| | Largemouth Bass | *Micropterus salmoides* | 1.2% | 2.2% | + | | + |
| | White Crappie | *Pomoxis annularis* | | | + | | + |
| | Black Crappie | *Pomoxis nigromaculatus* | | 0.6% | | | + |
| | Yellow Perch | *Perca flavescens* | 13.7% | 1.2% | + | | + |
| | Rainbow Tout | *Oncorhnchus mykiss* | 0.6% | | | | |
| | Gizzard shad | *Dorosoma cepedianum* | | 0.1% | | | + |
| | Round Goby | *Neogobius melanostomus* | 1.9% | 13.1% | + | | + |
| | Banded Killifish | *Fundulus diaphanus* | | | + | | |
| | Rainbow Smelt | *Osmerus mordax* | 1.9% | 1.1% | | | |
| | White Perch | *Morone americana* | 1.2% | | | | |
| | Goldfish | *Carassius auratus* | | | | | + |
| | Common Carp | *Cyprinus carpio* | 1.2% | | | | + |
| | Rudd | *Scardinius erythrophthalamus* | | | | | + |
| | #species | *44* | 17 | 27 | 20 | | 35 |
| | #fish caught | | 161 | 1384 | | | |
| | MEAN #fish/1000ES | | 85 | 346 | | | |

Legend for Table 13

| | | | | | |
|---|---|---|---|---|---|
| 🟩 | Native minnows & darters | 🟧 | Native sportfish | THR | Threatened |
| 🟨 | Sunfish family (other than sportfish) | ⬜ | Sucker family | END | Endangered |
| 🟦 | Exotic species, including exotic sportfish | | | SC | Special Concern |

### 4.3.1 Chippawa Channel Tributaries

Three Chippawa Channel tributaries were sampled; Tea Creek, Grassy Brook Creek and Lyons Creek (east). Tea Creek as its name suggests is a boggy, tea-colored groundwater fed system that originates from Willoughby Marsh. Tea Creek is a tributary of Lyon's Creek and is the only Chippawa Channel tributary with groundwater contribution resulting in year-round flow. Grassy Brook intercepts groundwater as indicated by brook stickleback in the mid reach, but becomes intermittent with isolated pools at its upstream extent. Lyons Creek receives year-round flow augmentation from the Welland Canal and provides the greatest extent of summer habitat of the Chippawa tributaries. Sampling in Lyon's Creek also included Hunters Drain, a small tributary near the mouth Lyon's Creek with very limited summer habitat. Fish abundance in each of these systems reflects the amount of available resident habitat (Figure 31).

Species common to the Chippawa Channel tributaries are similar to those common to the Niagara River tributaries (Table 14) but also include grass pickerel (COSEWIC Special Concern) and tadpole madtom. Of significance is the population of lake chubsucker (COSEWIC Endangered) in upper portions of Lyons Creek (east). Lake chubsucker were historically present in Tea Creek near the confluence with Lyons Creek, however, it is suspected the population has retreated into Lyons Creek because of the clearer water contributions from the canal augmentation. Resident distribution of lake chubsucker in Lyon's creek does not extend into the lower half of the creek where periodic dredging removes sand and gravel bars and much of the aquatic vegetation.

Similar to the Upper Niagara River tributaries, the Chippawa Channel tributaries support YOY and juvenile stages of the migratory river species, such as greater redhorse, shorthead redhorse and muskellunge. These tributaries are also accessed by migrating river minnows, as seen by occasional presence of schools of emerald shiners and spottail shiners. Compared to the Niagara River tributaries, resident predators are more diverse and abundant in the Chippawa Channel tributaries with northern pike, largemouth bass, smallmouth bass and bowfin represented by both adult and juvenile age classes, as well as presence of adult channel catfish and grass pickerel. Evidence of spawning bowfin in MNR studies of the Niagara River watershed is unique to Tea Creek and Grassy Brook.

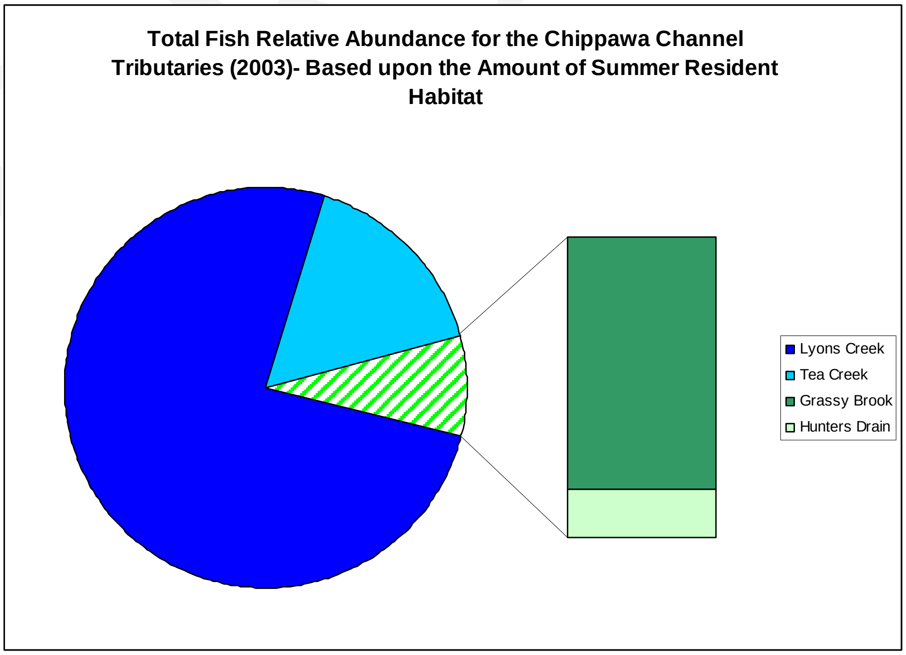

**Figure 31 Fish Relative Abundance for Chippawa Channel Tributaries Based on Summer Resident Habitat**

**Table 14 Species common in Chippawa tributaries**

| | | Also found in all NR tribs |
|---|---|---|
| Central Mudminnow | *Umbra limi* | + |
| Grass pickerel (SC) | *Esox americanus vermiculatus* | |
| White sucker | *Catostomus commersoni* | + |
| Golden Shiner | *Notemigonus crysoleucas* | + |
| Tadpole Madtom | *Noturus gyrinus* | |
| Brown Bullhead | *Ameiurus nebulosus* | + |
| Rock Bass | *Ambloplites rupestris* | + |
| Green Sunfish | *Lepomis cyanellus* | + |
| Pumpkinseed | *Lepomis gibbosus* | + |
| Bluegill | *Lepomis macrochirus* | + |
| Johnny Darter | *Etheostoma nigrum* | + |
| Largemouth Bass | *Micropterus salmoides* | + |
| Northern Pike | *Esox lucius* | + |
| Yellow Perch | *Perca flavescens* | + |
| Common Carp * | *Cyprinus carpio* | + |

## Lyons Creek (East) – Chippawa Channel Tributary

Lyons Creek (east) extends approximately 19.5km up to the New Welland Canal where flow in the creek is augmented with canal water. Prior to canal construction, the headwaters of Lyon's Creek originated in Wainfleet Bog approximately 7km west of the canal. Historic fish data for Lyon's Creek includes ROM records and records for a single station in 1996 sampled by a consultant. The 1996 station is not included in analysis, as technique was not compatible for comparative purposes however, the 1996 sampling caught YOY smallmouth bass, and rock bass indicating presence of coarse substrate in the creek. Additional notes from the 1996 survey indicate anecdotal reports of large sucker runs up Lyon's Creek. Sampling in 2003 covered 1 station at the upstream end near the canal by means of backpack electrofishing. Further sampling was not completed at the time due to safety concerns regarding contaminants in the substrate. Another single station was sampled within the creek mouth in 2004.

In 2006, 2 adult and 1 YOY lake chubsucker were recorded from the top end of the creek near the canal. Lake chubsucker is a Species-at-Risk (COSEWIC – Endangered) recorded historically from Tea Creek, a nearby tributary of Lyons Creek (Figure 32). Since that discovery, specialized boat electrofishing gear was obtained for extensive sampling to determine extent and habitat use of lake chubsucker in Lyon's Creek. 12 stations were sampled in 2008 and were concentrated in the upper end. Sampling in 2009 filled in gaps in mid reaches and confirmed a wider distribution up to Montrose Rd (Figure 33). Lake chubsucker are considered nationally significant due to their restricted range to southwestern Ontario. They typically inhabit clear, well vegetated, slower moving water with gravel, sand, silt and organic debris substrate types. Sampling stations in Lyon's Creek where lake chubsucker were collected are described as having clear water over muck substrate with moderate submerged and emergent vegetation, woody debris, boulders and undercut banks. Channel morphology is described as pools and flats. Sampling collected 1-year old fish and 1 to 2 older age classes in each of 2008 and 2009 sampling. Distribution extends from the canal down through the upper half of the creek reach. Periodic dredging in the lower half of the creek apparently removes habitat suitable for lake chubsucker.

**Figure 32 Lyons Creek East Lake Chubsucker Fall 2008**

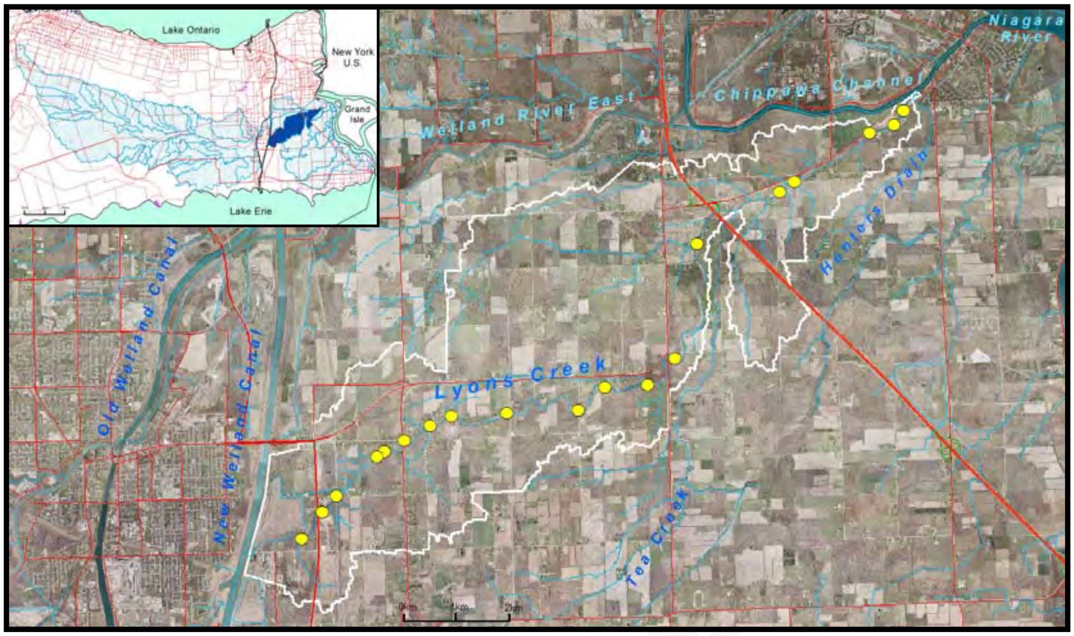

Figure 33 Lyons Creek Sampling Locations

Table 15 gives the relative abundance of species for each of the sampling years and shows historic ROM records. Collections include Species-at-Risk grass pickerel (COSEWIC – Special Concern) and 4 exotics including rudd, which is expanding its range from the Niagara River. Species recorded historically for the creek not found in recent sampling are mimic shiner and striped shiner. Occurrence of YOY shorthead redhorse, juvenile greater redhorse, rock bass, Johnny darter, logperch and smallmouth bass near the mouth of the creek suggest a component of coarser substrate in the lower portion of the creek. Predators in Lyon's Creek include bowfin, adult largemouth bass and northern pike, grass pickerel and channel catfish. Larger sized largemouth bass and white suckers in the creek during July suggest year-round residency. YOY of largemouth bass and white sucker were collected throughout the length of the creek. Minnows (predominantly bluntnose minnow and golden shiner) are the most abundant group in both the 2003 and 2004 surveys and form more than 40% of the relative abundance in 2008-2009. Small schools of spottail shiner and emerald shiner collected in 2008 and 2011 when sampling was conducted later in the year indicate movement of river species into the tributary. YOY shorthead redhorse also suggests use of Lyon's creek for spring migrations of spawning adults.

**Lyons Creek Summary**

| | |
|---|---|
| Summer Flow regime: | Artificial permanent flow from Welland Canal, 19.5km of permanent residual summer habitat, hectare calculation not available. No known migration barriers |
| Historic Data: | Headwaters pre 1829 was the Wainfleet Bog, ROM Historic data, 1996 MNR data |
| Restorative Work | No known projects. |
| Habitat | Boulder and rock within a loose fine substrate in the headwaters near the canal. Moderate submerged and emergent marsh vegetation. |
| Fish Community Objectives: | Maintain flow augmentation from Welland Canal<br>Assess fish community with respect to PCB contamination<br>Maintain connectivity to Chippawa channel/ Niagara River<br>Maintain or improve habitat to support grass pickerel and lake chubsucker |
| Manangement Recommendations: | Improve riparian habitat quality in watershed<br>Maintain and improve wetland habitat<br>Continue to monitor extent of Lake Chubsucker range in tributary |

## Table 15 Species Presence and Relative Abundance Lyons Creek 2003

| COSEWIC | Common Name | Scientific Name | 2011 Oct 1stn mouth | 2009 Jul-Aug 5stns | 2008 Oct 12 stns | 2004 Sep 1stn mouth | 2003 Sep 1 stn canal | MNR 1976-1991 | ROM |
|---|---|---|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | 1.89% | 1.8% | 0.7% | | | + | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 0.63% | 1.8% | 1.1% | | 0.7% | | |
| | Central Mudminnow | *Umbra limi* | | | 0.2% | | | | |
| END | Lake Chubsucker | *Erimyzon sucetta* | | 3.5% | 1.7% | | | | + |
| | White sucker | *Catostomus commersoni* | | 1.0% | 2.1% | 0.7% | | + | |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | | 4.0% | | | |
| | Greater Redhorse | *Moxostoma valenciennesi* | 0.63% | | 0.2% | | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.63% | 1.0% | 1.4% | 0.7% | | | + |
| | Tadpole Madtom | *Noturus gyrinus* | | 0.2% | 0.4% | | 0.7% | | |
| | Channel Catfish | *Ictalurus punctatus* | | | | 0.7% | | | |
| | Johnny Darter | *Etheostoma nigrum* | | 0.4% | | 2.0% | | | |
| | Logperch | *Percina caprodes* | | | | 0.7% | | | |
| | Freshwater Drum | *Aplodinotus grunniens* | | 0.1% | | | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 11.32% | 8.8% | 20.7% | 33.3% | | + | + |
| | Emerald Shiner | *Notropis atherinoides* | 0.63% | | 0.5% | | | | + |
| | Common Shiner | *Luxilus cornutus* | | | 0.4% | | | | + |
| | Spottail Shiner | *Notropis hudsonius* | 2.52% | | 0.4% | | | + | + |
| | Mimic Shiner | *Notropis volucellus* | | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 26.42% | 33.5% | 6.4% | 22.7% | 51.5% | + | + |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | | | | + |
| | Rock Bass | *Ambloplites rupestris* | 0.63% | 0.8% | 0.3% | 0.7% | 4.5% | + | |
| | Green Sunfish | *Lepomis cyanellus* | 0.63% | 0.7% | 1.3% | | 20.9% | | |
| | Pumpkinseed | *Lepomis gibbosus* | 11.95% | 28.9% | 32.9% | 16.0% | 9.0% | + | + |
| | Bluegill | *Lepomis macrochirus* | 27.04% | 3.5% | 14.2% | 0.7% | | + | |
| | Sunfish family | | 1.26% | | | | | | |
| | Smallmouth Bass | *Micropterus dolomieu* | | | 0.1% | | | | |
| | Largemouth Bass | *Micropterus salmoides* | 10.07% | 7.4% | 10.9% | 8.7% | 1.5% | + | |
| | White Crappie | *Pomoxis annularis* | | 0.4% | | 2.0% | | | |
| | Black Crappie | *Pomoxis nigromaculatus* | 0.63% | 0.2% | 1.93% | | | | |
| | Northern Pike | *Esox lucius* | 0.63% | | 0.3% | | | | |
| | Yellow Perch | *Perca flavescens* | 1.26% | 4.7% | 0.5% | 6.0% | | | + |
| | Round Goby | *Neogobius melanostomus* | | 0.2% | | | | | |
| | Goldfish | *Carassius auratus* | | | 0.7% | 0.7% | 11.2% | + | |
| | Common Carp | *Cyprinus carpio* | 1.26% | 0.7% | 0.9% | 0.7% | | | + |
| | Rudd | *Scardinius erythrophthalamus* | | 0.1% | | | | | |
| | *# SPECIES* | 34 | 17 | 21 | 24 | 16 | 8 | 10 | 12 |
| | *#FISH caught* | | 159 | 666 | 1370 | 147 | 119 | | |
| | *MEAN #fish/1000ES* | | n/a | 75 | 106 | n/a | n/a | | |

Legend for Table 15

| | | **COSEWIC Status** | |
|---|---|---|---|
| 🟩 | Native Minnow family | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | Th | Threatened |
| 🟧 | Native sportfish | + | Denotes presence |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes historic presence only |
| ▨ | Sucker family | | |

## Hunters Drain – Tributary of Lyons Creek

Hunters Drain is a tributary of Lyons Creek with approximately 0.07km of summer habitat. Summer sampling was limited to 1 location near the mouth. An additional 2 stations were sampled further upstream in November of the same year following replenishing rains. These sites are 0.3km and 0.7km upstream of the station at the mouth. No repeat sampling occurred and there are no known historic surveys. All surveys were conducted by backpack electrofishing (Figure 34).

### Hunters Drain Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent flow, 0.07km of residual summer habitat, ~ 0.66ha |
| | No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Moderate submerged, floating & emergent vegetation. Mix of boulder & rock in clay substrate. |
| Fish Community Objectives: | Maintain connectivity to Chippawa Channel/Niagara River |
| Manangement Recommendations: | Improve riparian habitat to maximize flood plain storeage and sustained base flows |

Table 16Table 16 gives the relative abundance of the 8 species collected in 2003. Pumpkinseed, YOY white suckers and YOY largemouth bass dominate the catch. Sampling in November found schools of common shiners and YOY white sucker at both upstream sites. Despite having little residual summer habitat Hunter Drain contributes spawning and rearing habitat for white sucker and largemouth bass, and demonstrates the dynamic nature of precipitation driven systems showing how extent of habitat can change 10-fold through the year.

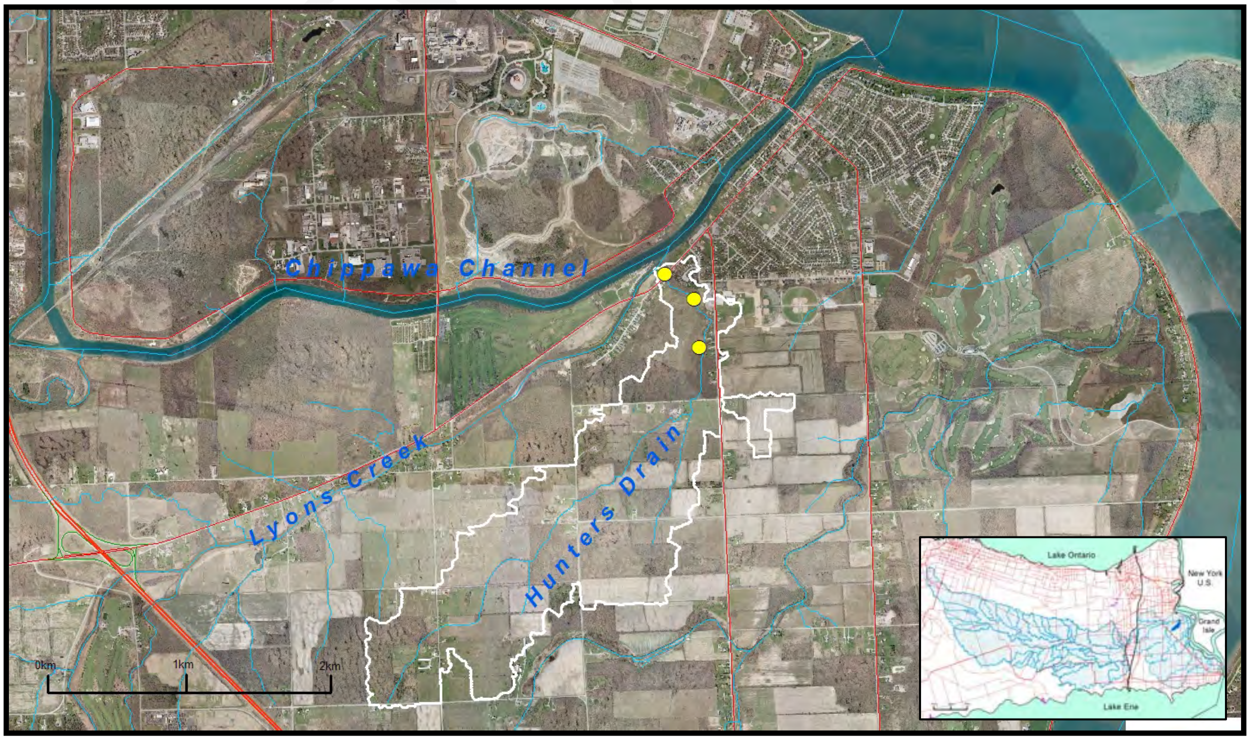

**Figure 34 Hunters Drain Sampling Locations**

## Hunters Drain Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent flow, 0.07km of residual summer habitat, ~ 0.66ha<br>No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Moderate submerged, floating & emergent vegetation. Mix of boulder & rock in clay substrate. |
| Fish Community Objectives: | Maintain connectivity to Chippawa Channel/Niagara River |
| Manangement Recommendations: | Improve riparian habitat to maximize flood plain storeage and sustained base flows |

**Table 16 Species Presence and Relative Abundance Hunters Drain 2003**

| COS EWIC | Common Name | Scientific Name | 2003 Jul 1 stn | 2003 Nov 2 stns |
|---|---|---|---|---|
| | Central Mudminnow | *Umbra limi* | 5.5% | |
| | White sucker | *Catostomus commersoni* | 18.2% | 10.5% |
| | Emerald Shiner | *Notropis atherinoides* | 1.8% | |
| | Common Shiner | *Luxilus cornutus* | | 89.5% |
| | Green Sunfish | *Lepomis cyanellus* | 1.8% | |
| | Pumpkinseed | *Lepomis gibbosus* | 25.5% | |
| | Bluegill | *Lepomis macrochirus* | 7.3% | |
| | Largemouth Bass | *Micropterus salmoides* | 40.0% | |
| | *# SPECIES* | *8* | 7 | 2 |
| | *#fish caught* | | 55 | 38 |
| | *MEAN #fish/1000ES* | | n/a | n/a |

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟧 | Native sportfish |
| 🟨 | Sunfish family (other than sportfish) | ⬜ | Sucker family |

## Tea Creek – Tributary of Lyon's Creek

Tea Creek is a groundwater fed tributary of Lyons Creek with approximately 3.82km of continuous summer creek length up from the mouth. Above that point the creek is intermittent up to its headwaters in Willoughby Marsh. Sampling in 2003 covered 2 stations in the permanent habitat of the lower reaches, and 3 stations within the intermittent headwaters (Figure 35). Sampling includes both backpack electrofishing and seining. Two of the headwater stations were at isolated, remnant pools associated with road crossing culverts. The third headwater station was within a groundwater discharge area with extensive marsh habitat. This latter station was repeated in 2004, 2005 and 2009 using the seine method established in 2003. Survey results for all survey periods are presented in Table 17 as relative abundance. The 25 species recorded from Tea Creek include one Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 1 exotic: common carp. Seven historic native species not captured in recent sampling are lake chubsucker (COSEWIC – Endangered), greater redhorse, yellow bullhead, logperch, rainbow darter, spottail shiner, rock bass and black crappie.

The lake chubsucker population once found in Tea Creek is likely extirpated as a result of habitat degradation. The historically occupied reaches in Tea Creek are now degraded, as much of Tea Creek has become an entrenched channel and is now classified as a municipal drain. It is unlikey that the range of the population from Lyon's Creek will expand to Tea Creek as the areas are now separated from Lyon's Creek by large distances of poor habitat. Part of the drainage management regulating municipal drains allows for raw sewage application to fields adjacent to the creek, and sampling in Tea Creek in July 2009 after field application resulted in no fish caught at the repeat station and the next station downstream. At the time of this sampling there was a strong smell of manure and dead fish were observed. Repeat sampling in September saw the reoccurrence of fish, but it should be noted that grass pickerel has not been collected from Tea Creek since 2003. In 2003 grass pickerel were collected from the 2 stations in the downstream reaches with permanent water, as well as the repeat station (intermittent with groundwater discharge) where 8 individuals were captured. Largemouth bass are mostly young–of-the-year (YOY) but include larger fish. Both adults and YOY of bowfin were collected. Evidence of spawning bowfin is unique to this tributary and Grassy Brook. In 2005 & 2009 when summer precipitation was higher than normal, number of fish caught at the repeat station is more than twice that caught in drier years.

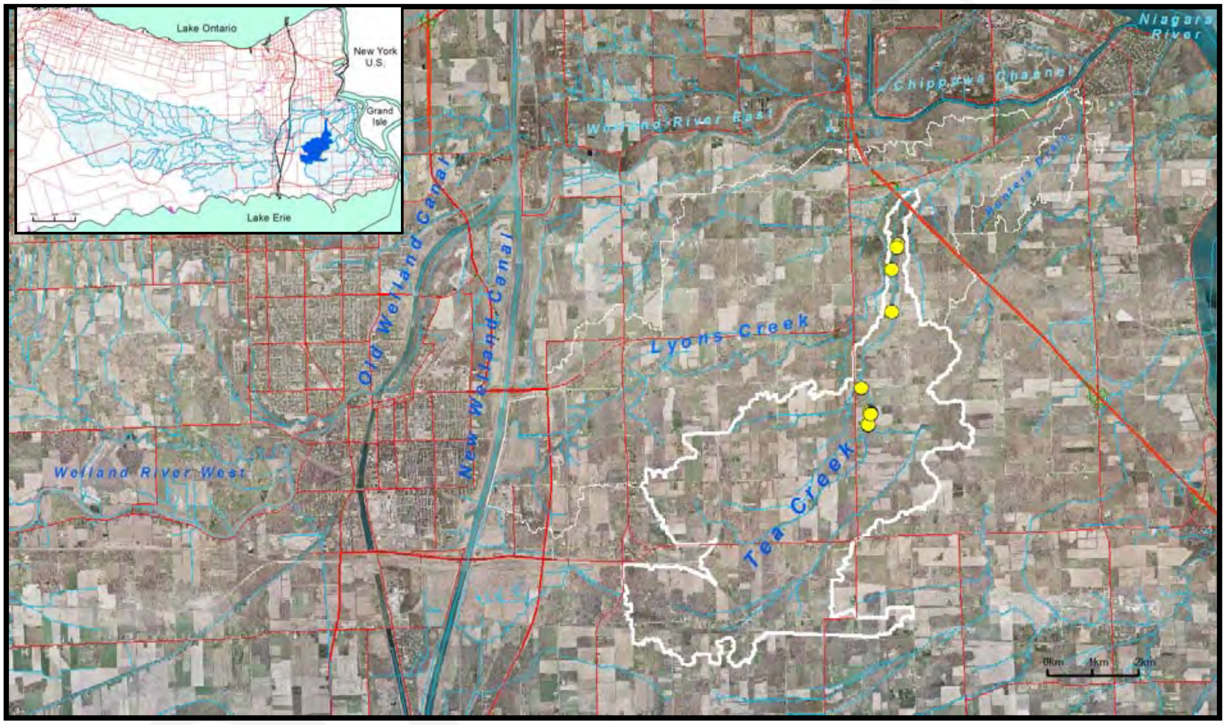

**Figure 35 Tea Creek Sampling Locations**

## Tea Creek Summary

| | |
|---|---|
| Summer Flow regime: | Permanent flows, 3.82km of permanent residual summer habitat, plus remnant pool habitat in the headwaters, 3.07ha. No known migration barriers |
| Historic Data: | ROM Historic data |
| Restorative Work | No known projects. Drain clean out downstream of Kotmier Rd. in 1992. |
| Habitat | Closest station to Lyons Creek is clay with sparse instream habitat. Upstream a mix of predominantly loose fines with moderate to abundant submergent and emergent vegetation, to harder clay with rubble and sparse vegetation. |
| Fish Community Objectives: | Maintain base flows<br>Maintain connectivity to Chippawa channel/ Niagara River<br>Maintain or improve habitat to support Grass Pickerel |
| Manangement Recommendations: | Improve riparian habitat quality in watershed<br>Maintain and improve wetland habitat along creek to Willoughby Marsh |

**Table 17 Species Presence and Relative Abundance Tea Creek**

| | | | | Repeat Station in remnant pool | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| COSEWIC | Common Name | Scientific Name | 2009 Aug-Sep 4stns | 2009 Sep | 2005 Jul | 2004 Jun | 2003 Aug | 2003 Aug 5stns | ROM |
| | Bowfin | *Amia calva* | 1.2% | 0.2% | 0.2% | 13.0% | 1.2% | 3.0% | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | 9.4% | 3.3% | + |
| | Central Mudminnow | *Umbra limi* | 6.9% | 4.2% | 6.9% | 9.0% | 30.6% | 10.3% | + |
| | White sucker | *Catostomus commersoni* | | | 0.2% | | | 1.2% | + |
| END | Lake Chubsucker | *Erimyon sucetta* | | | | | | | + |
| | Greater Redhorse | *Moxostoma valenciennesi* | | | | | | | + |
| | Black Bullhead | *Ameiurus melas* | | | 1.6% | 2.0% | | | + |
| | Yellow Bullhead | *Ameiurus natalis* | | | | | | | + |
| | Brown Bullhead | *Ameiurus nebulosus* | | | 31.4% | 22.0% | 1.2% | 7.3% | |
| | Tadpole Madtom | *Noturus gyrinus* | | | 0.7% | 1.5% | | 1.8% | + |
| | Rainbow Darter | *Etheostoma caeruleum* | | | | | | | + |
| | Johnny Darter | *Etheostoma nigrum* | | | 0.5% | 0.5% | | 3.0% | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 72.7% | 77.4% | 30.6% | 19.0% | 30.6% | 17.3% | + |
| | Common Shiner | *Luxilus cornutus* | | | | | 11.8% | 3.3% | |
| | Spottail Shiner | *Notropis hudsonius* | | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | | | | | | | + |
| | Rock Bass | *Ambloplites rupestris* | | | | | | | + |
| | Green Sunfish | *Lepomis cyanellus* | 8.8% | 6.7% | 7.3% | 10.0% | 1.2% | 3.3% | |
| | Pumpkinseed | *Lepomis gibbosus* | 0.4% | 0.4% | 13.1% | 17.5% | 1.2% | 31.9% | + |
| | Bluegill | *Lepomis macrochirus* | 1.5% | 1.7% | 0.7% | 4.5% | 1.2% | 2.4% | + |
| | Northern Pike | *Esox lucius* | | | 0.4% | 1.0% | 4.7% | 4.6% | |
| | Largemouth Bass | *Micropterus salmoides* | 8.6% | 9.4% | 6.4% | | 7.1% | 6.4% | + |
| | Black Crappie | *Pomoxis nigromaculatus* | | | | | | | + |
| | Yellow Perch | *Perca flavescens* | | | | | | 0.3% | + |
| | Common Carp | *Cyprinus carpio* | | | | | | 0.3% | + |
| | *# SPECIES* | 25 | 7 | 7 | 13 | 11 | 11 | 16 | 20 |
| | *#fish caught* | | 1030 | 909 | 563 | 200 | 87 | 329 | |

Legend for Table 17

| | | COSEWIC Status | |
|---|---|---|---|
| 🟩 | Native Minnow family | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | THR | Threatened |
| 🟧 | Native sportfish | + | Denotes presence |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes historic presence only |
| ⬜ | Sucker family | | |

## Grassy Brook – Chippawa Channel Tributary

Grassy Brook discharges opposite the confluence of the Welland River East, the Chippawa Channel and the Power Canal. Grassy Brook has approximately 1.6km of continuous summer creek length from the mouth up, above which the creek is intermittent. Sampling in 2003 consisted of one station in the permanent habitat of the lower reach, and two stations at isolated remnant pools associated with road crossing culverts within the intermittent length. All 3 stations were sampled with a seine net. The station in permanent habitat was resampled in 2005. A fourth station was sampled at the mouth by boat electrofishing in 2004. In 2009, 4 stations were sampled in the upstream reaches to include shallow narrow runs by backpack electrofishing and pool habitat by seining (Figure 36).

Results for all survey periods are presented in Table 18 as relative abundance. The 29 species recorded from Grassy Brook include one Species at Risk, grass pickerel (COSEWIC – Special Concern) and 2 exotics; gizzard shad and common carp. Striped shiner was found historically in the creek, but not recaptured with recent sampling. In the 2003 comprehensive sampling, central mudminnow (35.7%) and northern pike (15.2%) are most abundant in the upstream isolated pools.

Boat electrofishing in 2004 sampled habitat closer to the mouth adding bowfin, gizzard shad, spottail shiner, juvenile muskellunge and YOY shorthead redhorse to the species pool for Grassy Brook. Sampling in the headwaters in 2009 added brook stickleback (indicative of groundwater discharge to the creek) and creek chub to the species list.

August sampling in 2005 caught a small run of emerald shiner that was undetected when the creek was sampled again in September of that year. Minnows are absent from the repeat sampling station in 2 of the three sampling years, which are coincidental with presence of adult and juvenile northern pike. Largemouth bass in Grassy Brook are largely YOY, but include occasional larger individuals. White sucker were all of YOY size.

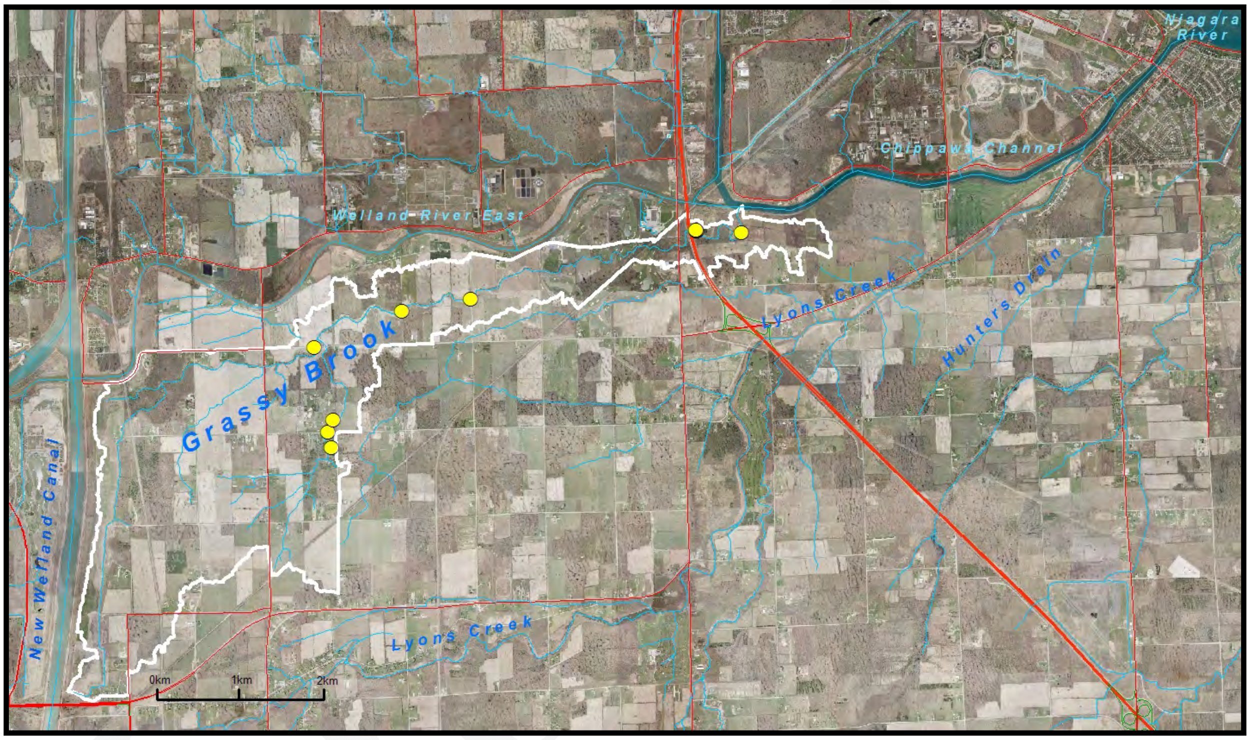

**Figure 36 Grassy Brook Sampling Locations**

## Grassy Brook Summary

| | |
|---|---|
| Summer Flow regime: | 1.64km of permanent residual summer habitat, plus remnant pool habitat in the headwaters, 0.81ha.<br>No known migration barriers |
| Historic Data: | ROM Historic data |
| Restorative Work | Restoration design for the lower reach to narrow the baseflow channel and increase structure has not implemented. |
| Habitat | Clay substrate with sparse rock, rubble, gravel and pockets of loose fines. Instream vegetation is sparse. |

## Table 18 Species Presence and Relative Abundance Grassy Brook

| | | | head waters | Mouth (boat) | Repeat Stn 1 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| COSEWIC | Common Name | Scientific Name | 2009 Oct 4stns | 2004 Sept 1stn | 2005 Sep | 2005 Aug | 2003 Aug | 2003 Aug 3stns | ROM |
| | Bowfin | *Amia calva* | | 0.7% | | | | | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | 1.3% | |
| | Central Mudminnow | *Umbra limi* | 24.1% | | | | 7.7% | 35.7% | |
| | White sucker | *Catostomus commersoni* | | 4.3% | 0.7% | 4.4% | 1.5% | 0.4% | |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | 1.4% | | | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 1.0% | | | | | 14.8% | |
| | Tadpole Madtom | *Noturus gyrinus* | | | 0.7% | | | | |
| | Trout-perch | *Percopsis omiscomaycus* | | | | | 35.4% | 10.0% | |
| | Johnny Darter | *Etheostoma nigrum* | | 0.7% | 15.1% | 3.3% | 24.6% | 7.0% | + |
| | Logperch | *Percina caprodes* | | | | | 1.5% | 0.4% | |
| | Brook Stickleback | *Culaea inconstans* | 1.0% | | | | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 16.9% | 35.5% | | 5.5% | | 1.3% | |
| | Emerald Shiner | *Notropis atherinoides* | | | | 1.1% | | | + |
| | Spottail Shiner | *Notropis hudsonius* | | 2.8% | | | | | |
| | Bluntnose Minnow | *Pimephales notatus* | | 3.5% | | | | | + |
| | Fathead Minnow | *Pimephales promelas* | | | | 3.3% | | | |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | | | | + |
| | Creek Chub | *Semotilus atromaculatus* | 1.4% | | | | | | |
| | Rock Bass | *Ambloplites rupestris* | | 5.0% | | 1.1% | | | |
| | Green Sunfish | *Lepomis cyanellus* | 39.1% | 5.0% | 15.1% | 3.3% | 1.5% | 6.1% | |
| | Pumpkinseed | *Lepomis gibbosus* | 1.6% | 14.2% | 31.7% | 33.0% | 3.1% | 1.3% | |
| | Bluegill | *Lepomis macrochirus* | 10.2% | 12.8% | 3.6% | 3.3% | | | |
| | sunfish | *Lepomis* sp. | | 2.1% | | | | | |
| | Northern Pike | *Esox lucius* | 0.1% | | 0.7% | | 3.1% | 15.2% | + |
| | Muskellunge | *Esox masquinongy* | | 1.4% | | | | | |
| | Largemouth Bass | *Micropterus salmoides* | 4.4% | 5.7% | 31.0% | 34.1% | 6.2% | 1.7% | |
| | White Crappie | *Pomoxis annularis* | | 0.7% | 0.7% | 7.7% | 1.5% | 0.4% | |
| | Yellow Perch | *Perca flavescens* | | 0.7% | 0.7% | | 13.8% | 3.9% | |
| | Gizzard Shad | *Dorosoma cepedianum* | | 2.1% | | | | | |
| | Common Carp | *Cyprinus carpio* | 0.3% | 1.4% | | | | 0.4% | |
| | *#SPECIES* | *29* | 11 | 18 | 10 | 11 | 11 | 15 | 5 |
| | *#fish caught* | | 700 | 141 | 139 | 91 | 65 | 230 | |

### Legend for Table 18

| | | COSEWIC Status | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | + | Denotes historic presence only |

## 4.4 QUEENSTON RESERVOIR

The 174 megawatt Sir Adam Beck Pump Generating Station and its 300-hectare reservoir, known locally as the Queenston Reservoir were constructed concurrent with the Sir Adam Beck II Generating Station under the authority of the Niagara Diversion Treaty of 1950. Lake Erie/Upper Niagara River flows are diverted to the Sir Adam Beck generating complex through the Power Canal diversion and typically pumped into the reservoir at night so it can be used to generate electricity during periods of higher demand. Six pump-turbines were installed at the pump generating station and are capable of filling the reservoir, in about eight hours[7]. In 2011, OPG and Golder and Associate consultants completed a fish salvage/rescue and relocation operation during a maintenance exercise. This was the first dewatering of the reservoir since 1958 and was completed under the authority of MNR. Although some periodic netting was completed in the past, this was the first comprehensive fish survey within the reservoir and represents the fish community entrained through the Power Canal diversion. Given the ongoing operation of the reservoir, and that water is usually always present within the reservoir, and that most of these species are short lived; fish are likely added to the reservoir on an ongoing basis. A total of 8696 fish were captured comprising 25 species (Table 19). This study provides direct evidence of fish entrainment into the power canal and reservoir but does not define a time scale to determine a rate of entrainment. Unfortunately fish ageing was not completed, which would have added insight into establishing an entrainment rate.

Previous netting surveys in the 1980's documented 18 species inhabiting the reservoir. At that time the reservoir supported a local perch and bass fishery, now closed due to public safety concerns. The river redhorse (Species at Risk – Special Concern) recorded in 1999 was not verified and is not otherwise recorded from the Niagara River watershed and is likely a misidentified greater redhorse (*Moxostoma valenciennesi*). The fish community in the reservoir included species most typically found in the Upper Niagara River which are predominantly warmwater and to a lesser extent coldwater species. Some notable species include walleye, brown and rainbow trout, silver and greater redhorse, largemouth and smallmouth bass. Most of the predatory, longer living species were large, adult sized specimens however, large numbers of small cyprinid species representing 22% of the catch were also captured. Given the size of the pumps it is likely that fish are entrained at a small size and the longer living species survive and grow for a number of years, feeding off the smaller individuals. Therefore the fish community in the reservoir is likely representative of the relative abundance of all small forage and other YOY and juvenile fish entrained from the Welland River and Upper Niagara River through the Power Canal at the Triangle Island junction.

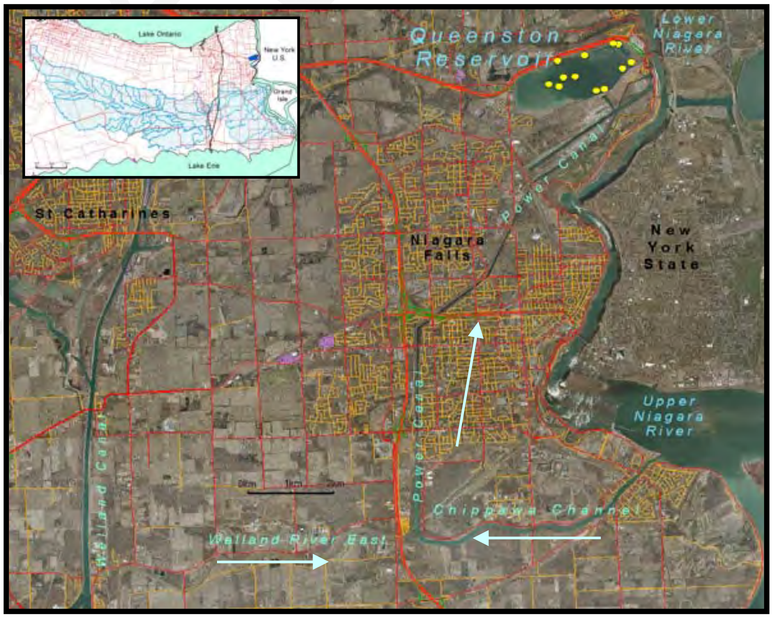

**Figure 37 Queenston Reservoir Sampling Stations (yellow). Arrows indicate direction of flow towards the reservoir.**

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[7] http://www.opg.com/power/hydro/niagara_plant_group/adambeckpgs.asp

## Table 19 Species Presence and Relative Abundance Queenston Reservoir

| COSEWIC | Common Name | Scientific Name | 2011 Oct 100% collection | 1989 Gill net survey | Other records |
|---|---|---|---|---|---|
| | Quiliback Carpsucker | *Carpiodes cyprinus* | 0.3% | | |
| | White sucker | *Catostomus commersoni* | 0.6% | + | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | + | |
| | Silver Redhorse | *Moxostoma anisurum* | 0.1% | | |
| | Greater Redhorse | *Moxostoma valenciennesi* | <0.1% | | |
| SC | River Redhorse[8] | *Moxostoma carinatum* | | + | |
| | Brown Bullhead | *Ameiurus nebulosus* | <0.1% | | |
| | Channel Catfish | *Ictalurus punctatus* | 0.1% | + | |
| | Stonecat | *Noturus flavus* | | + | |
| | Freshwater Drum | *Aplodinotus grunniens* | 0.6% | + | |
| | Emerald Shiner | *Notropis atherinoides* | 17.5% | | |
| | Spottail Shiner | *Notropis hudsonius* | 4.1% | | |
| | Sand Shiner | *Notropis stramineus* | | | + |
| | White bass | *Morone chyrsops* | | + | |
| | Rock Bass | *Ambloplites rupestris* | 1.34% | + | |
| | Green Sunfish | *Lepomis cyanellus* | <0.1% | | |
| | Pumpkinseed | *Lepomis gibbosus* | <0.1% | | |
| | Smallmouth Bass | *Micropterus dolomieu* | 11.3% | + | + |
| | Largemouth Bass | *Micropterus salmoides* | 10.1% | | |
| | White Crappie | *Pomoxis annularis* | | | |
| | Black Crappie | *Pomoxis nigromaculatus* | | | |
| | Northern Pike | *Esox lucius* | 0.7% | | |
| | Yellow Perch | *Perca flavescens* | 6.6% | + | + |
| | Walleye | *Stizostedion vitreum* | 0.1% | | |
| | White Perch | *Morone americana* | 0.1% | + | |
| | Rainbow Trout | *Oncorhnchus mykiss* | 0.3% | | + |
| | Brown Trout | *Salmo trutt* | <0.1% | | + |
| | Coho Salmon | *Oncorhynchus kisutch* | | | + |
| | Round Goby | *Neogobius melanostomus* | 9.5% | | |
| | Banded killifish | *Fundulus diaphanus* | | | + |
| | Alewife | *Alsoa pseudoharengus* | 24.8% | + | |
| | Gizzard Shad | *Dorosoma cepedianum* | <0.1% | | |
| | Goldfish | *Carassius auratus* | | | |
| | Common Carp | *Cyprinus carpio* | 22.2% | + | + |
| | Rudd | *Scardinius erythrophthalamus* | 0.4% | | |
| | *# SPECIES* | 34 | 25 | | |
| | *#FISH caught* | | 8696 | | |
| | *MEAN #fish/1000ES* | | n/a | | |

| | | | |
|---|---|---|---|
| ▨ | Sucker family | 🟦 | Exotic species, including exotic sportfish |
| 🟩 | Native Minnow family | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | + | Denotes presence |
| 🟧 | Native sportfish | | |

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[8] River redhorse (*Moxostoma caranatum*) is unkown from the Niagara River watershed, and this collection was not verified by Royal Ontario Museum, and is therefore likely a misidentified greater redhorse (*Moxostoma valenciennesi*).

## 4.5 WELLAND RIVER EAST

The Welland River East (WRE) is a 10.6 km section that extends from its confluence with the Power Canal and Chippawa Channel west to the New Welland Shipping Canal syphon structure and includes a small section (650m) of the original channel in Port Robinson (discussed in section 2.2.1). MNR differentiates this area from the rest of the Welland Canal because of the presence of a river diversion structure at the upstream end, and the channelization created by the realignment of the river to accommodate the new canal in 1973. Flow is derived from a mix of relatively clear canal water and turbid Welland River water and clarity is reduced compared to the Chippawa Channel and the Niagara River.

In October 1997 three stations were sampled at the upstream end of this ARA. September 2004 sampled at 5 locations (Figure 38). Some stations were repeated in 2008 (4stns) and 2011 (3stns). Boat electrofishing at each station in 2004 covered approximately 500m of river shore length over the duration of 1000 electrofishing seconds. Sampling rate was 235m/km, close to the mean of 226m/km for all large bodied ARAs. Mean CPUE was 307 N/1000ES ± 243 (95% CL) indicating a high variance between sample stations. An increase in station sampling is recommended in this ARA or further subdividing of this section into more uniform habitat types related to the habitat variation around the confluence with the Power Canal and Chippawa Channel. Thirty-nine species were collected in this ARA, 35 of them from the main stem. Surveys had a similar catch per unit effort between sample events (Table 20). Seven species caught in 2004 were not found in 1997. Two of these, round goby and rudd, are recent non native species that first appeared in the watershed after 1999. Muskellunge, smallmouth bass, logperch and gizzard shad were not captured in 1997 which may be a reflection of increased sampling including two sites at the Power Canal confluence. Only mimic shiner, caught in 1997, was not found in 2004. A brindled madtom was captured for the first time in this ARA during 2008 sampling. This find is significant given their difficulty to be captured with electrofishing techniques. Shocked individuals tend to bury themselves in loose bottom substrate and under rocks, out of the reach of the netters. White sucker and 2 redhorse species are represented by YOY, juveniles and large adults in the main stem, but were not detected in the one year of sampling of the only tributary in the ARA (Thompson Creek).

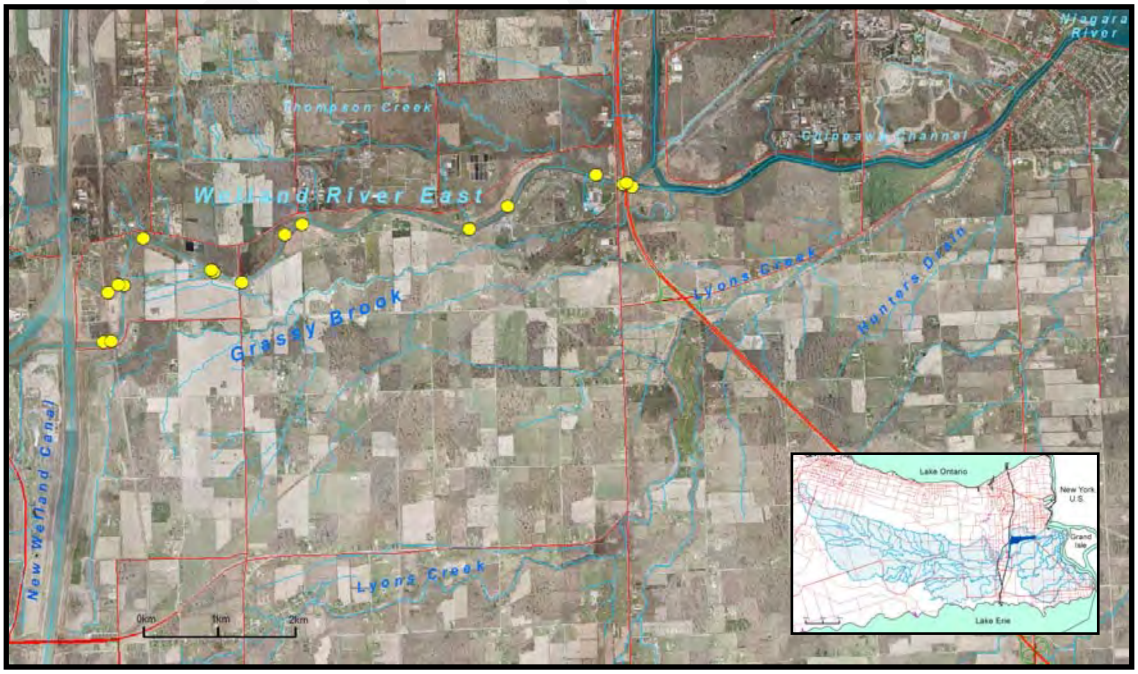


Figure 38 Welland River East Sampling Locations

## Table 20 Species Presence and Relative Abundance Data Welland River East

| COSEWIC | Common Name | Scientific Name | 2011 Sep 3stns | 2008 Oct 4stns | 2004 Sep 5stns | 1997 Oct 3stns | Tribs 2003-2009 |
|---|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | 0.5% | | 0.2% | 0.1% | |
| | White sucker | *Catostomus commersoni* | 0.7% | 2.4% | 1.3% | 0.8% | |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | 0.2% | 2.0% | |
| | Greater Redhorse | *Moxostoma valenciennesi* | 0.2% | 0.9% | | 0.8% | |
| | Redhorse sp. | *Moxostoma* sp | 0.2% | | 1.9% | | |
| | Central Mudminnow | *Umbra limi* | | | | 0.5% | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.5% | 0.9% | 0.5% | 0.6% | + |
| | Channel Catfish | *Ictalurus punctatus* | | | 0.1% | 0.1% | |
| | Brindled Madtom | *Noturus miurus* | | 0.1% | | | |
| | Brook Stickleback | *Culaea inconstans* | | | | | + |
| | Johnny Darter | *Etheostoma nigrum* | | 0.4% | 0.3% | 0.4% | + |
| | Logperch | *Percina caprodes* | 1.3% | | 0.1% | | |
| | Brook Silverside | *Labidesthes sicculus* | 2.3% | 10.9% | | 0.4% | |
| | Golden Shiner | *Notemigonus crysoleucas* | 6.8% | 2.0% | 7.0% | 0.4% | + |
| | Emerald Shiner | *Notropis atherinoides* | 3.2% | 20.8% | 4.3% | 8.7% | + |
| | Spottail Shiner | *Notropis hudsonius* | 1.9% | 24.3% | 15.9% | 0.6% | |
| | Mimic Shiner | *Notropis volucellus* | | | | 0.1% | |
| | Bluntnose Minnow | *Pimephales notatus* | 40.6% | 20.7% | 32.6% | 28.0% | + |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | 0.4% | + |
| | Creek Chub | *Semotilus atromaculatus* | | | | | + |
| | Minnow sp | *Cyprinidae* | | | 0.2% | | |
| | Rock Bass | *Ambloplites rupestris* | 2.8% | 0.6% | 14.8% | 12.2% | |
| | Green Sunfish | *Lepomis cyanellus* | 0.2% | | 0.6% | 3.0% | + |
| | Pumpkinseed | *Lepomis gibbosus* | 10.2% | | 3.8% | 11.7% | + |
| | Bluegill | *Lepomis macrochirus* | | 0.4% | 0.8% | 0.3% | |
| | Sunfish | *Centrarchidae* | 4.0% | | 0.7% | | |
| | Smallmouth Bass | *Micropterus dolomieui* | 1.4% | 0.1% | 0.1% | | |
| | Largemouth Bass | *Micropterus salmoides* | 10.7% | 7.7% | 7.4% | 15.6% | + |
| | White Crappie | *Pomoxis annularis* | | 0.1% | 0.9% | 1.9% | |
| | Black Crappie | *Pomoxis nigromaculatus* | 0.3% | | 0.1% | 1.0% | |
| | Northern Pike | *Esox lucius* | 1.0% | 0.9% | 0.4% | 0.6% | + |
| | Muskellunge | *Esox masquinongy* | | | 0.1% | | |
| | Yellow Perch | *Perca flavescens* | 0.3% | 3.4% | 3.0% | 2.5% | |
| | Alewife | *Alsoa pseudoharengus* | | | | | + |
| | Gizzard shad | *Dorosoma cepedianum* | | 1.7% | | | |
| | Round Goby | *Neogobius melanostomus* | | 0.6% | 0.9% | | + |
| | Banded Killifish | *Fundulus diaphanus* | | 1.0% | 0.2% | 0.4% | |
| | Goldfish | *Carassius auratus* | 0.5% | 0.1% | 0.1% | 0.5% | + |
| | Common Carp | *Cyprinus carpio* | 2.9% | 0.1% | 1.8% | 6.6% | |
| | Rudd | *Scardinius erythrophthalmus* | 1.5% | | 0.1% | | |
| | #SPECIES | 39 | 23 | 22 | 27 | 27 | 16 |
| | #fish caught | | 618 | 996 | 1537 | 797 | |
| | MEAN#fish/1000ES | | 206 | 249 | 307 | 266 | |

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, including exotic sportfish |
| 🟨 | Sunfish family (other than sportfish) | ▨ | Sucker family |
| 🟧 | Native sportfish | SC | Special Concern |

## 4.5.1 Welland River East Tributary

### Thompson Creek

Thompson Creek is the only tributary large enough to sample in the Welland River East ARA. The tributary has 2 branches, the smaller of which intercepts groundwater from the Niagara Falls moraine. The larger branch receives augmented flow from the Welland River through industrial processing which requires extra water for cooling purposes. Even with the contribution of the groundwater fed branch, the combined flow from the 2 tributaries results in a warm thermal plume continuously discharged to the Welland River (MNR unpublished data).

There is no historic fish data for Thompson Creek. Recent sampling conducted in mid September included 1 station on the groundwater fed branch, and 4 stations along the branch with industrial effluent (Figure 39). Results are presented in Table 21. The branch with groundwater discharge recorded 441 brook stickleback in the 30m section of creek sampled, as well as YOY largemouth bass and juvenile northern pike (stn 2). The other branch shows obvious signs of fish mortality near the industrial feed (stns 3 & 4), including dead fish in the creek at the station where no fish were caught (stn 3). Field notes indicate water colour to be an opaque yellowish/brown with a bad smell. The next station approximately 40m downstream had much reduced fish abundance (8 fish in total, stn 4). This branch improves by the next stations 1km downstream (stns 1 & 5) where numbers and diversity have increased. The station furthest downstream from the industrial effluent sampled 36 YOY largemouth bass, and 5 species of minnow including emerald shiner and a school of 66 bluntnose minnow.

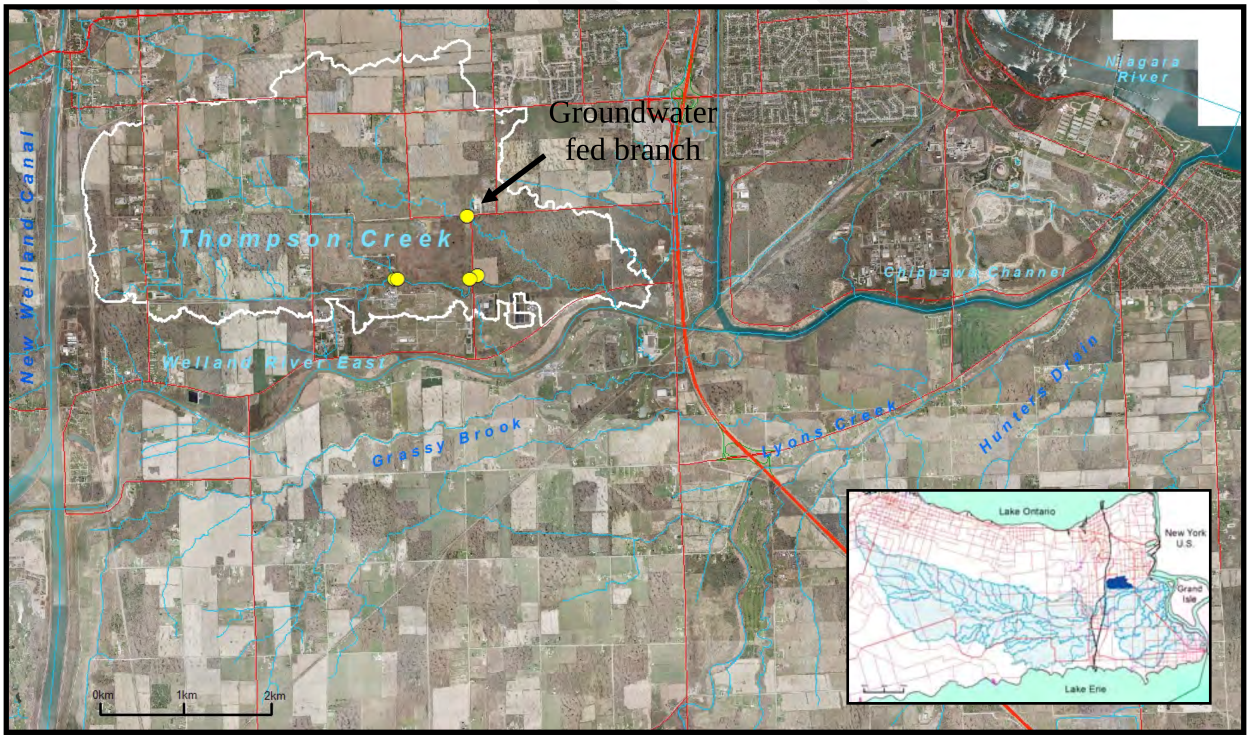


Figure 39 Thompson Creek Sampling Locations

## Thompson Creek Summary

| | |
|---|---|
| Summer Flow regime: | ~6km of permanent residual summer habitat with groundwater and surface flow augmentation, possible remnant pool habitat in the headwaters.<br>No known migration barriers |
| Historic Data: | None |
| Restorative Work | None |
| Habitat | Clay substrate with sparse rock, rubble, gravel and pockets of loose fines. Instream vegetation is sparse. |
| Management Recommendations | None prescribed at this time |

**Table 21 Species Relative Abundance for Thompson Creek**

| | | | Industrial Effluent Branch | | | | Gwater branch |
|---|---|---|---|---|---|---|---|
| | | | Near industrial plant | | 1km d/s of industrial plant | | |
| COSEWIC | Common Name | Scientific Name | 2009 Sep Stn3 | 2009 Sep Stn4 | 2009 Sep Stn1 | 2009 Sep Stn5 | 2009 Sep Stn2 |
| | Central Mudminnow | *Umbra limi* | | 12.5% | 1.8% | | |
| | Brown Bullhead | *Ameiurus nebulosus* | | | 3.6% | 1.4% | |
| | Johnny Darter | *Etheostoma nigrum* | | | | 2.0% | |
| | Brook Stickleback | *Culaea inconstans* | | | | | 91.7% |
| | Golden Shiner | *Notemigonus crysoleucas* | | | 1.8% | 3.5% | |
| | Emerald Shiner | *Notropis atherinoides* | | | 1.8% | 9.5% | |
| | Bluntnose Minnow | *Pimephales notatus* | | | 49.1% | 44.6% | 0.4% |
| | Striped Shiner | *Luxilus chrysocephalus* | | | | 0.7% | |
| | Creek Chub | *Semotilus atromaculatus* | | | | 1.4% | |
| | Green Sunfish | *Lepomis cyanellus* | | 87.5% | 12.7% | 2.0% | 4.2% |
| | Pumpkinseed | *Lepomis gibbosus* | | | | 4.7% | 0.2% |
| | Northern Pike | *Esox lucius* | | | | | 0.2% |
| | Largemouth Bass | *Micropterus salmoides* | | | 16.4% | 24.4% | 3.3% |
| | Alewife | *Alsoa pseudoharengus* | | | 9.1% | 2.7% | |
| | Round Goby | *Neogobius melanostomus* | | | 3.6% | 2.7% | |
| | Goldfish | *Carassius auratus* | | | | 0.7% | |
| | #SPECIES | *16* | 0 | 2 | 9 | 13 | 6 |
| | # Fish Collected | | 0 | 8 | 55 | 148 | 481 |

Legend for Table 18

| | |
|---|---|
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |

## *4.6 WELLAND RIVER BETWEEN THE OLD AND NEW WELLAND CANALS*

This 5.4 km long ARA is situated between two diversion structures (syphons) carrying the river under the canals: the Old Canal syphon located at the upstream (west) end and the New Canal syphon located at the downstream (east) end, (see section 2.2.1 for detailed description). Flow is augmented with clear, cool, oligotrophic Lake Erie water supplied through holes in the bottom of the canal at the upstream end of the ARA (Old Canal syphons). This part of the Welland River also receives clear discharge water from the municipal water treatment plant near the west end of the ARA, and discharge from the sewage treatment plant about midway along the ARA. Several stormwater sewer outfalls exist through this section, some of which are Combined Sewer Overflows (CSO's). A contaminated heavy metal reef (Atlas reef) was removed from this section in mid 1990's (NRRAP, 2009).

Sampling for this study covered 4 years and included spring and fall sampling. Boat electrofishing at each station covered approximately 500m of river shore length over the duration of 1000 electrofishing seconds. In 2004 sampling rate was 370m/km, well above the mean of 226m/km for all large bodied ARAs. Mean CPUE was 137 N/1000ES +- 82 (95% CL), which is less than half the mean CPUE of the previous ARAs. Sampling in 2004 followed summertime CSO discharge events. Welland City Residents in the vicinity of Fitch Street had sewage backed up into their basements following a series of heavy rain events. Floating sewage debris was evident during the 2004 sampling events. These events may have influenced catch results in that season, though compared to other years, species diversity and abundance does not appear to show an effect. Sampling in November 2007 included sampling the discharge flow from the water treatment plant and the thermal plume discharge from the sewage treatment plant to assess the influence of these flows on fish community metrics.

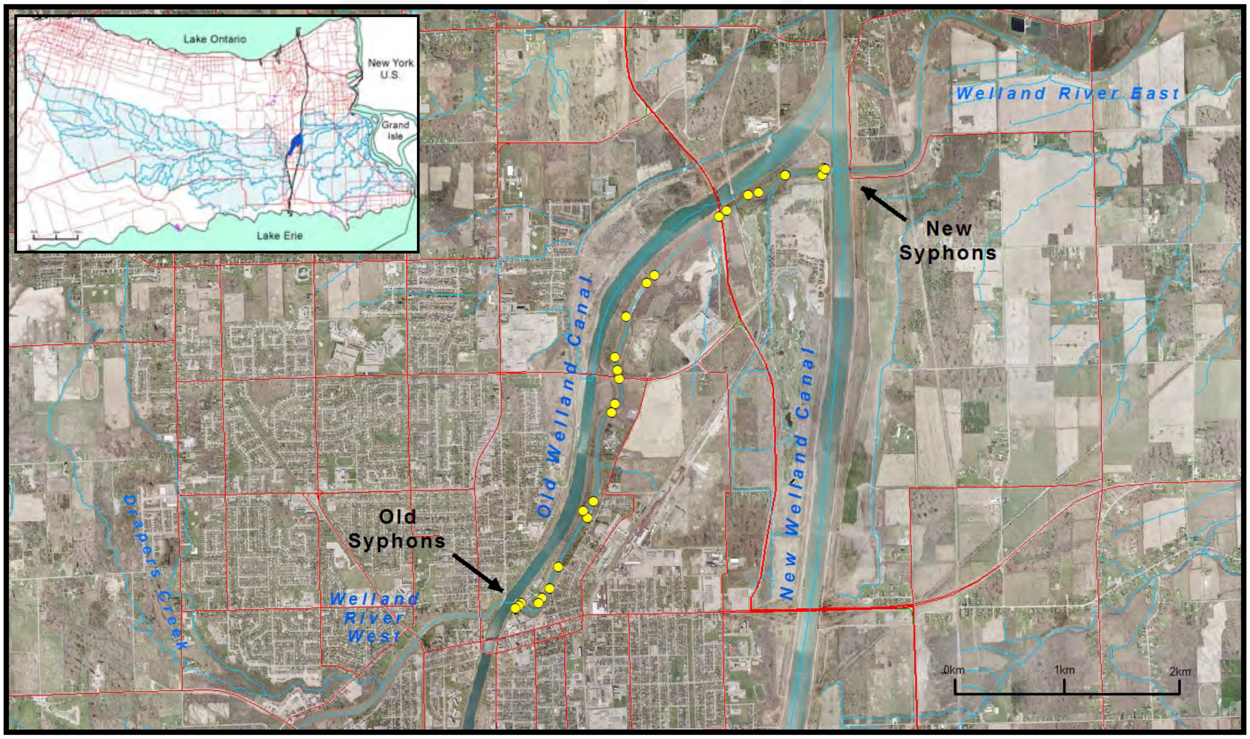


**Figure 40 Welland River between the Old and New Canals Sampling Locations**

Results from these samplings added 12 species for this ARA since the 1997 survey (Table 22). Sampling in the treatment plant discharges did not result in any unique species, but distribution of some species appears to be influenced by the concentrated flow or the temperature plume, as large schools of gizzard shad and emerald shiner were found around the sewage treatment outflow. A school of black crappie and the single rainbow trout were collected near the water treatment plant outflow. Other studies have shown the flow from the water treatment plant is an attractant to fish (Biotactic

Forty-one species recorded for this ARA include 8 exotics. Two species that appear (smallmouth bass and bigmouth buffalo) show sporadic distribution in the broader context of the Niagara River watershed. These species are both common Lake Erie fish and it is suspected their presence is associated with flow connection to the Old Welland Canal and a more direct link with the Lake Erie fishery. Bigmouth buffalo has not been recorded for any downstream ARAs. Smallmouth bass are most common to this section of the Welland River suggesting they are not moving upstream from the Niagara River, but entering the area from the Old Welland Canal, where they are abundant (Yagi, 1998). This is the best evidence of fish movement between the Old Welland Canal and the Welland River. Seasonal variation as evidence by schools of emerald shiners and gizzard shad, and capture of rainbow trout in spring and fall surveys also suggests fish passage from the Old Canal, however, it is unclear to what extent if any migration is filtered by the structure. Round-bodied suckers include 4 species. For 2 of these 4, abundance is limited to single occurrences of large adults (golden redhorse and greater redhorse), and juveniles are absent. Shorthead redhorse are slightly more common (2 - 8 individuals in any one sampling season). White sucker are the most common (7 – 14 individuals in a sampling season). Both these species are predominantly adults but include an occasional YOY. In downstream ARAs juveniles and YOY are more abundant and found in both the main stem and in their tributaries. This ARA is within a heavily manipulated landscape having no tributaries. Low abundances of sucker species may reflect a migratory filter at the New Welland Canal syphon (at the downstream end of the ARA) and poor representation of YOY and juvenile sized individuals may reflect lack of suitable habitat for spawning, or poor survivorship of young.

Muskellunge, first captured by boat electrofishing in May 2008 in this ARA, confirmed previous angler catch reports. Anecdotal reports from anglers indicate muskellunge is an incidental occurrence here and not a common catch. According to angling records the largest population of muskellunge is in the Upper Niagara River, which suggests that muskellunge found between the canals is the result of upstream movement through the new syphon. However, there are also reported captures by anglers in Gravelly Bay Lake Erie and in Lake Gibson / Welland Canal area. Therefore the exact movement pattern for this species remains unclear as introduction through the Old Canal siphon can not be ruled out. Since the winter of 1961/62 when massive fish kills were reported in the Welland River (Department of Energy and Resources Management, 1965) walleye had not been detected in this ARA until 2005 (angler reports and MNR trap net catches). Annual walleye stocking in the Welland River upstream of Port Davidson, ~30km upstream of the Old Canal, began in 1997. By 2004 adult walleye appeared in sampling both upstream of Port Davidson, near the stocking site, and in the Welland River West, indicating survival of stocked fish and downstream dispersal. By 2005, six class cohorts were detected in the river including collections from between the canals suggesting further downstream dispersal and downstream passage through the Old Canal siphons[9]. In 2007, local fish clubs with MNR permission stocked walleye to this ARA. Concerns regarding viral hemorrhagic septicemia (VHS) prevented stocking of walleye upstream of the Old Welland Canal in 2007. This moratorium is in effect until VHS is known to occur upstream. A YOY walleye captured in the fall 2007 indicated some survival of that year's stocked fish. Spring 2008 electrofishing confirmedspawning activity within this ARA, with the capture of aggregations of walleye in spawning condition, however there has no subsequent sampling to confirm spawning success.

---

[9] DNA sampling to confirm origin of walleye was not undertaken.

## Table 22 Species Presence and Relative Abundance Data Welland River Between-the-Canals

| COWEWIC | Common Name | Scientific Name | 2008<br>May<br>5 stns | 2007<br>Nov<br>6 stns | 2005<br>Aug<br>3 stns | 2004<br>Aug/Sep<br>4 stns | 1997<br>Oct<br>4 stns |
|---|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | <0.1% | 0.4% | | 0.2% | 0.6% |
| | White sucker | *Catostomus commersoni* | 0.3% | 1.7% | 2.0% | 1.8% | 2.3% |
| NAR | Bigmouth Buffalo | *Ictiobus cyprinellus* | | 0.4% | | | 0.2% |
| | Golden Redhorse | *Moxostoma erythrurum* | <0.1% | | 0.3% | | |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | 2.0% | 0.4% | 0.9% |
| | Greater Redhorse | *Moxostoma valenciennesi* | <0.1% | | | | 0.2% |
| | Redhorse species | *Moxostoma* sp | | 0.6% | | | |
| | Black Bullhead | *Ameiurus melas* | | 0.2% | | 0.2% | |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.1% | 1.9% | 0.6% | 0.5% | 2.2% |
| | Channel Catfish | *Ictalurus punctatus* | | | 0.6% | | 0.3% |
| | Johnny Darter | *Etheostoma nigrum* | <0.1% | 0.9% | | 0.5% | 0.6% |
| | Logperch | *Percina caprodes* | <0.1% | 0.4% | | | |
| | Brook Silverside | *Labidesthes sicculus* | | 5.7% | 2.0% | | |
| | Freshwater Drum | *Aplodinotus grunniens* | <0.1% | | 0.3% | | 0.6% |
| | Golden Shiner | *Notemigonus crysoleucas* | | 3.4% | 7.4% | 2.9% | 3.1% |
| | Emerald Shiner | *Notropis atherinoides* | 97.2% | 39.6% | 7.1% | | 45.4% |
| | Common Shiner | *Luxilus cornutus* | | 0.2% | | 0.5% | |
| | Spottail Shiner | *Notropis hudsonius* | 0.1% | | 1.4% | 0.2% | 2.2% |
| | Bluntnose Minnow | *Pimephales notatus* | 0.5% | 3.6% | 13.3% | 24.2% | 6.9% |
| | Fathead Minnow | *Pimephales promelas* | | | 0.3% | 2.7% | |
| | Rock Bass | *Ambloplites rupestris* | | 3.4% | 11.6% | 16.5% | 9.9% |
| | Green Sunfish | *Lepomis cyanellus* | | 0.4% | 0.3% | 6.0% | 0.6% |
| | Pumpkinseed | *Lepomis gibbosus* | 0.1% | 6.5% | 16.1% | 16.0% | 5.4% |
| | Bluegill | *Lepomis macrochirus* | | 0.4% | 4.2% | 3.1% | 0.2% |
| | Smallmouth Bass | *Micropterus dolomieui* | 0.2% | 0.6% | 3.4% | 2.2% | 0.8% |
| | Largemouth Bass | *Micropterus salmoides* | 0.2% | 3.4% | 13.0% | 4.2% | 2.3% |
| | White Crappie | *Pomoxis annularis* | 0.1% | | | 0.2% | 0.9% |
| | Black Crappie | *Pomoxis nigromaculatus* | | 3.6% | 1.1% | 0.4% | 0.5% |
| | Northern Pike | *Esox lucius* | 0.1% | 0.8% | 0.3% | 1.5% | 2.3% |
| | Muskellunge | *Esox masquinongy* | <0.1% | anecdotal | | | |
| | Yellow Perch | *Perca flavescens* | <0.1% | 0.9% | 2.3% | 8.7% | 5.7% |
| | Walleye | *Stizostedion vitreum* | 0.3% | 0.2% | + | | |
| | Rainbow Trout | *Oncorhnchus mykiss* | <0.1% | 0.4% | | | |
| | Alewife | *Alosa pseudoharengus* | | | | | 0.3% |
| | Gizzard shad | *Dorosoma cepedianum* | | 16.4% | 8.5% | | 0.3% |
| | White Perch | *Morone americana* | | | | | 0.2% |
| | Banded Killifish | *Fundulus diaphanus* | | | | | 0.9% |
| | Round Goby | *Neogobius melanostomus* | | | | 5.8% | |
| | Rainbow Smelt | *Osmerus mordax* | | | | | 0.3% |
| | Common Carp | *Cyprinus carpio* | 0.6% | 3.2% | 2.0% | 0.9% | 4.0% |
| | Rudd | *Scardinius erythrophthalmus* | | | | 0.4% | |
| | #Species | *41* | 21 | 27 | 23 | 24 | 29 |
| | #fish caught | | 4115 | 535 | 353 | 551 | 648 |
| | MEAN #fish/1000ES | | 823 | 90 | 118 | 138 | 162 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 🟩 | Native Minnow family | ⬜ | Sucker family | 🟧 | Native sportfish | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | 🟦 | Exotic species | | | + | present |

## 4.7 WELLAND RIVER WEST TO PORT DAVIDSON WEIR

The Welland River West ARA extends 30kms west from the Fourth Canal syphon structure to a weir structure at Port Davidson (**Error! Reference source not found.**). Water is withheld in this section by elevation controls on the Niagara River (section 2.2). Surface water connection with the bottom of the Old Canal syphon structure allows clear canal water to flow freely into the Welland River. Because of the low gradient river system and the diurnal flow reversal, clear canal water flows into the river both upstream and downstream depending on the time of day. When the clear water flows upstream it results in a reverse turbidity gradient. The water is clearest near the syphon for the first 2 km of channel and then turbid conditions gradually increase in a westerly direction (Yagi, 1997). The ebb and flow of water from the canal acts to improve water quality through dilution of this 2 km section of river. It also acts to prevent upstream flows and sediments from discharging during the low flow seasons (summer and winter) for the remaining 28km of channel. The Port Davidson weir is the upstream endpoint for effects of flow reversal.

Main channel flow in this ARA is derived largely from precipitation. Base flow contributions from a few small headwater springs and low flow augmentation from Binbrook reservoir are not sufficient to maintain a positive downstream gradient during summer and winter months. Some species distribution in this area shows habitat partitioning reflecting poorer water quality during the summer season. Walleye for example show a range expansion outside of the summer low flow season (discussed further in the ARA Summary in Section 5.9).

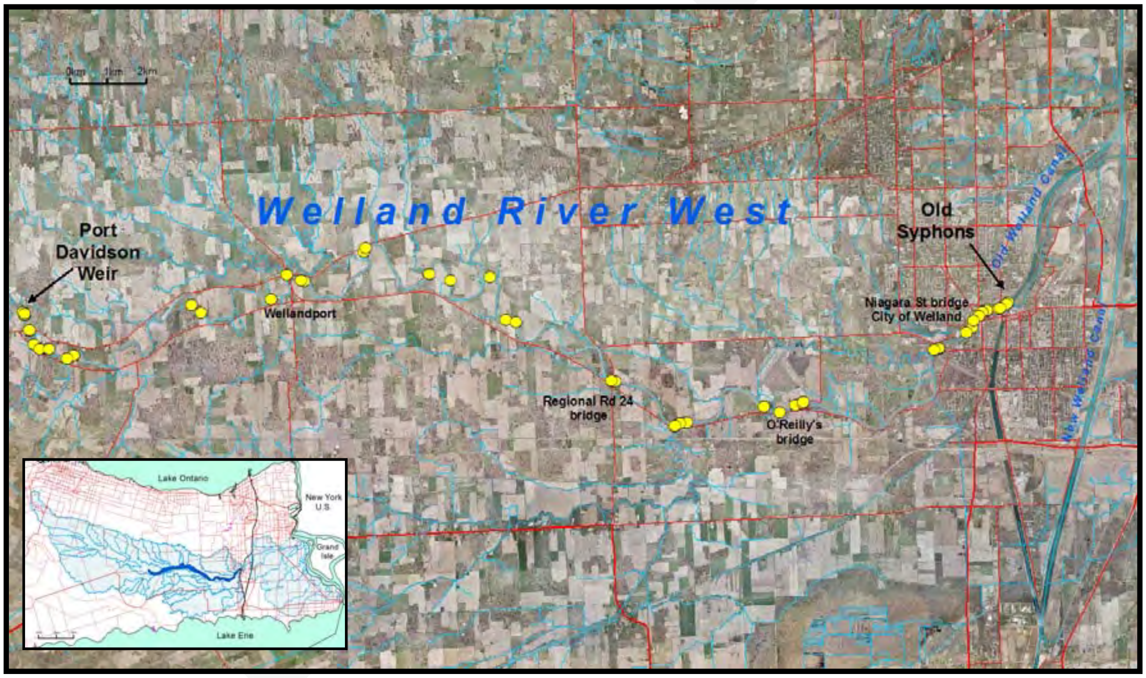


**Figure 41 Welland River West Sampling Locations**

Boat electrofishing covered 3 low flow seasons sampled in August, each station covering approximately 500m of river shore length over the duration of 1000ES. In 2004, nine stations were sampled for a sample rate of 156 m/km, below the mean 226m/km for all large bodied ARAs. Similar to the previous ARA, CSO discharges were evident during the August 2004 sample period and may have resulted in a lower CPUE (CPUE of 59.9N/1000ES in 2004 compared to the CPUE in the next downstream ARA (CPUE 137N/1000ES in Welland River between-the-canals). CPUE in 2005 was 155N/1000ES when sampling covered 15 stations at a rate of 250m/km of river. Sampling in 2008 covered 8 stations as part of a spring walleye spawning survey.

All fish species previously identified from trap net, seine, minnow trap and gill net studies were captured using boat electrofishing, except for blue walleye (COSEWIC – Extinct), central mudminnow and spottail shiner (Cairn, 1932; DOERM, 1964) (Table 24). Six addition species were added through the use of boat electrofishing (Table 25) including bigmouth buffalo (COSEWIC – Not at Risk).

Piscivores in this ARA include channel catfish, largemouth bass, bowfin, northern pike, walleye and smallmouth bass. Sampling in 2005 by overnight trap netting as part of a walleye survey (data not shown) collected a predominance of large catfish (over 500 in one 3-night setting) and their distribution and abundance are likely under-estimated by boat electrofishing alone. Largemouth bass appear throughout the ARA and include several age classes from YOY to adult. Bowfin and northern pike are much less abundant in fish surveys than either catfish and bass and are generally large adults with an occasionally juvenile-sized fish. Telemetry studies of pike activity suggest that adult habitat is limiting in the Welland River West watershed (Biotactic, 2003). Walleye, recently re-introduced (1997 to 2006), have sustained themselves in portions of this ARA, concentrated during the low flow season in the higher water quality areas of the river; in the first 2km west of the syphon, near Oswego Creek and Port Davidson. Small mouth bass were collected in 2005 by means of overnight trap netting within the clearer water in the first 2km west of the syphon (data not shown) and in the same area during spring 2008 surveys. It is thought they entered the ARA by means of flow augmentation from the Old Welland Canal at the Old Canal syphons.

**Figure 42 Welland River West Walleye May 2008**

Transient large schools of migrating minnows and other smaller fish appear to be absent in the Welland River West suggesting a migration barrier into this ARA. Sampling in the spring of 2008 demonstrates upstream filtering of emerald shiner. Almost 4000 individuals were captured in the Welland River Between-the-Canals. Sampling at the same time in the Welland River West collected just 130 individuals. Distribution of other species suggests a full migrational barrier as they are absent above the 4th canal syphon. Spottail shiner is common in all ARAs below the syphons and while they were collected in the Welland River West in historic surveys conducted before the creation of the syphons, they have not been collected upstream of the syphons since they were built. Other species' distributions show them to be in the Welland River as far upstream as the Old Canal Syphons, but not above also suggesting a migration barrier. These include golden redhorse, muskellunge, rainbow trout, banded killifish, rainbow smelt, alewife, round goby and rudd. The sucker diversity is also reduced to 2 of the 5 species collected from the next downstream ARA (Welland River Between-the-Canals) suggesting the syphons may act as a partial barrier to this fish family. An incidental occurrence of a greater redhorse individual collected from above Port Davidson suggests either some passage through the syphons or possibly a bait bucket release, nevertheless the restricted distribution and low abudnaces mean the population is filtered from upstream movement.

In the Welland River West, walleye, emerald shiner, rock bass, shorthead redhorse, Johnny darter are uncommon with small numbers occurring in a discontinuous but predictable pattern. They are found in association with one another around bridge abutments and the habitat enhancement project in the Welland River at the mouth of Big Forks Creek. Compared to other sampling stations, the stations where these fish are found have narrowed channel configuration (increased flow) and/or addition of coarse substrate and large woody debris. The station around Big Forks Creek was sampled prior to the enhancement project and it was not until after the project that rock bass, emerald shiner and logperch were collected.

### Table 23 Location of species found only at sampling stations associated with bridge abuttments

| Station | Description | Rock Bass | Walleye | shorthead redhorse | emerald shiner | Johnny darter |
|---|---|---|---|---|---|---|
| WellR-01 | u/s side of 4th canal syphons | + | + | | | |
| WellR-02 | Prince Charles bridge | + | + | + | | |
| WellR-04 | Lincoln St Bridge | + | + | + | + | + |
| WellR-06 | O-Reilly's bridge | | + | | + | |
| WellR-07 | RR crossing and habitat enhancement project in Welland R at Big Forks Creek | + | | | + | |
| WellR-08 | RR24 crossing (Victoria Ave) | | | + | | |
| WellR-12 | Wellandport bridge | + | + | + | + | |
| WellR-14 | mouth of Oswego Creek includes island | | + | + | + | |
| WellR-15 | d/s Pt Davidson weir | | + | + | | |
| WellR-16 | u/s Pt Davidson RR crossing | | + | | + | |

### Table 24 Historic Fish Records for the Welland River West

| COWEWIC | Common Name | Scientific Name | R.F. Cairn July 1932* | Fishing Clubs 1954 to 1960 | DOERM 1964** | MOE 1993*** |
|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | | | + | |
| | Gizzard shad | *Dorosoma cepedianum* | | | | + |
| | Central Mudminnow | *Umbra limi* | | | + | |
| | White sucker | *Catostomus commersoni* | | | | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | | | + |
| | Brown Bullhead | *Ameiurus nebulosus* | | | + | |
| | Black Bullhead | *Ameiurus melas* | + | | | |
| | Yellow Bullhead | *Ameiurus natalis* | | | | + |
| | Channel Catfish | *Ictalurus punctatus* | + | | | + |
| | Tadpole Madtom | *Noturus gyrinus* | | | + | |
| | Johnny Darter | *Etheostoma nigrum* | | | + | |
| | Freshwater Drum | *Aplodinotus grunniens* | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | | | + | |
| | Emerald Shiner | *Notropis atherinoides* | | | + | |
| | Spottail Shiner | *Notropis hudsonius* | + | | + | |
| | Golden Shiner | *Notemigonus crysoleucas* | + | | + | |
| | Pumpkinseed | *Lepomis gibbosus* | + | | + | |
| | Largemouth Bass | *Micropterus salmoides* | | stocked | | |
| | Northern Pike | *Esox lucius* | + | | + | |
| | White Crappie | *Pomoxis annularis* | + | | + | + |
| | Black Crappie | *Pomoxis nigromaculatus* | + | | + | |
| | Yellow Perch | *Perca flavescens* | + | | + | |
| | Walleye | *Stizostedion vitreum* | | stocked | | |
| Ext | Blue Walleye | *Stizostedion vitreum glaucum* | + | | | |
| | Common Carp | *Cyprinus carpio* | + | | + | + |
| | White Perch | *Morone americana* | | | | + |
| | | Total species | 11 | | 15 | 9 |

**Gear type:** *****Index gill net; **Seine and trap net; ***Hoop net

| | |
|---|---|
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |
| 🟪 | Extinct and or locally extirpated from Lake Ontario Watershed |
| ⬜ | Sucker Species |

## Table 25 Species Presence and Relative Abundance Data -Welland River West

| COSEWIC | Common Name | Scientific Name | 2008<br>May<br>8stns | 2005<br>Aug<br>15stns | 2004<br>Aug<br>9stns | 1997<br>Aug<br>16stns | Tribs<br>2007 |
|---|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | 0.4% | 0.6% | 1.3% | 0.6% | + |
| | Gizzard shad | *Dorosoma cepedianum* | | 7.9% | 2.6% | 0.6% | + |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | + |
| | Central Mudminnow | *Umbra limi* | | | | | + |
| | White sucker | *Catostomus commersoni* | 0.1% | 0.1% | | 0.2% | + |
| NAR | Bigmouth Buffalo | *Ictiobus cyprinellus* | 3.1% | 1.3% | 0.9% | 1.1% | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | <0.1% | 0.7% | 0.1% | + |
| | Redhorse species | *Moxostoma sp.* | | | 0.4% | | |
| | Yellow Bullhead | *Ameiurus natalis* | 0.7% | 0.1% | 0.6% | 0.5% | + |
| | Black Bullhead | *Ameiurus melas* | | | | | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 7.0% | 3.4% | 7.7% | 19.6% | + |
| | Channel Catfish | *Ictalurus punctatus* | 0.8% | 1.0% | 2.2% | 7.6% | + |
| | Tadpole Madtom | *Noturus gyrinus* | | <0.1% | | | + |
| | Brook Stickleback | *Culaea inconstans* | | | | | + |
| | Johnny Darter | *Etheostoma nigrum* | | <0.1% | | | + |
| | Logperch | *Percina caprodes* | | 0.3% | | 0.1% | + |
| | Brook Silverside | *Labidesthes sicculus* | | <0.1% | 0.2% | 0.1% | |
| | Freshwater Drum | *Aplodinotus grunniens* | 3.6% | 2.1% | 5.5% | 9.0% | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 5.5% | 11.8% | 1.5% | 3.9% | + |
| | Emerald Shiner | *Notropis atherinoides* | 14.5% | 0.3% | 0.2% | 0.7% | |
| | Common Shiner | *Luxilus cornutus* | 2.0% | | 0.7% | | + |
| | Rosyface Shiner | *Notropis rubellus* | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | 3.1% | 2.8% | 1.3% | 0.3% | + |
| | Fathead Minnow | *Pimephales promelas* | | | | | + |
| | Creek Chub | *Semotilus atromaculatus* | | | | | + |
| | Rock Bass | *Ambloplites rupestris* | 0.5% | 0.6% | 0.6% | 0.1% | + |
| | Green Sunfish | *Lepomis cyanellus* | | 0.5% | 4.4% | 0.5% | + |
| | Pumpkinseed | *Lepomis gibbosus* | 30.0% | 33.5% | 44.3% | 25.5% | + |
| | Bluegill | *Lepomis macrochirus* | 5.2% | 8.9% | 5.0% | | + |
| | YOY sunfish | *Lepomis* sp. | | | 0.7% | | |
| | Largemouth Bass | *Micropterus salmoides* | 2.7% | 6.4% | 3.3% | 1.0% | + |
| | Smallmouth Bass | *Micropterus dolomieu* | 0.2% | | | | |
| | White Crappie | *Pomoxis annularis* | 3.1% | 1.0% | 0.9% | 9.6% | + |
| | Black Crappie | *Pomoxis nigromaculatus* | 1.0% | 2.1% | 2.2% | 0.6% | + |
| | Northern Pike | *Esox lucius* | 0.4% | 0.2% | 0.9% | 0.3% | + |
| | Yellow Perch | *Perca flavescens* | 5.6% | 8.8% | 3.7% | 4.9% | + |
| | Walleye | *Stizostedion vitreum* | 2.1% | 0.4% | 0.9% | | |
| | Goldfish | *Carassius auratus* | | <0.1% | 0.2% | 0.3% | + |
| | Common Carp | *Cyprinus carpio* | 6.1% | 3.5% | 5.5% | 11.3% | + |
| | White Perch | *Morone americana* | 2.1% | 3.8% | 1.7% | 1.6% | + |
| | #SPECIES | 38 | 23 | 29 | 26 | 25 | 33 |
| | #fish/ caught | | 839 | 2333 | 539 | 1044 | |
| | MEAN #fish/1000ES | | 105 | 155 | 60 | 65 | |

| | | | | | |
|---|---|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, incl. exotic sportfish | SC | Special Concern |
| 🟨 | Sunfish family (other than sportfish) | ▨ | Sucker family | NAR | Not at Risk |
| 🟧 | Native sportfish | + | Denotes pesence | + | Biotactic, 2003 |

### 4.7.1 Welland River West Tributaries

Sampling coverd the 5 main tributaries: Drapers Creek, Coyle Creek, Big Forks Creek, Beaver Creek (West Lincoln) and Oswego Creek. Sampling of smaller systems included Little Forks Creek, the old Feeder Canal and Sucker Creek. While sampling attempted to cover all tributaries with summer residual habitat, some remain inadequately sampled as MNR was not given access through private lands to most of the creek length (Beaver Creek) or they had no residual summer habitat at the time sampling. Tributaries of the Welland River West are largely precipitation driven but Coyle Creek, and Drapers Creek receive baseflow from the Fonthill Kame Morain to the north, and on the south side of the Welland River Big Forks Creek, Biederman Drain (trib to the old Feeder Canal) and Oswego Creek also intercept groundwater. Presence of brookstickleback in these systems indicates location of groundwater seeps. The highest relative abundance of fish was found in Oswego Creek and Big Forks Creek (including sampled tributaries) followed by Coyle Creek, Beaver Creek, Sucker Creek then Drapers Creek.

A total of 33 species have been recorded from Welland River West tributaries, 13 of which are common to the larger tributaries (Table 26). Black crappie and black bullhead are species common to all the Welland River West tributaries that were not listed as common in Chippawa Channel tributaries or the Niagara River tributaries. Grass pickerel, white sucker, rock bass, yellow perch and common carp were common in Chippawa Channel and Niagara River tributaries but not common to the Welland River West tributaries. Absence of grass pickerel from Drapers Creek is unexplained. Rosyface shiner was incidental in both Coyle Creek and Drapers Creek. Most of the Welland River West tributaries support YOY largemouth bass and northern pike, including branches classified as municipal drains. These drainage systems were once small first and second order tributaries or they were constructed across land to remove excess runoff from agricultural fields. For the most part, they are precipitation driven and provide limited residual fisheries habitat, and where present, it is often confined to residual pools and with some permanent water near the outlets. Despite limited habitat, many of the residuals pools on these drains support stranded fish communities of YOY piscivores that may opportunistically leave these areas to larger habitats during the next rain event. Welland River West tributaries differ from tributaries of downstream ARAs by the near absence of schools of gizzard shad, emerald shiner, spottail shiners and YOY suckers. White sucker distribution in the main river is limited to small occurrences near the mouths of Drapers Creek, Coyle Creek and Oswego Creek and tributary occurrences reflect this distribution as they are absent from all the other tributaries sampled. Shorthead redhorse shows similar mainstem distribution but was found only in the mouth of Oswego Creek. Other sucker species are absent with the exception of a single occurrence of quillback carp sucker in one sampling years in Oswego Creek.

**Table 26 Species Common to larger Welland River West tributaries**

| | | Also found in all Chippawa Channel tribs | Also found in all NR tribs |
|---|---|---|---|
| central mudminnow* | *Umbra limi* | + | + |
| golden shiner | *Notemigonus crysoleucas* | + | + |
| tadpole madtom | *Noturus gyrinus* | + | |
| brown bullhead | *Ameiurus nebulosus* | + | + |
| black bullhead | *Ameirus melas* | | |
| green sunfish | *Lepomis cyanellus* | + | + |
| pumpkinseed | *Lepomis gibbosus* | + | + |
| bluegill* | *Lepomis macrochirus* | + | + |
| Johnny darter* | *Etheostoma nigrum* | + | + |
| black crappie | *Poxomis nigromaculatus* | | |
| largemouth bass | *Micropterus salmoides* | + | + |
| northern pike | *Esox lucius* | + | + |
| common carp | *Cyprinus carpio* | + | + |

## Drapers Creek

Drapers Creek originates from groundwater discharges at the Fonthill Kame Moraine and has permanent flow over approximately 6.1km to where it outlets into the Welland River West approximately 24km upstream from the Niagara River. Drapers Creek has been the subject of several restoration projects to remove migration barriers, re-establish riparian communities, increase habitat structure, and control erosion. This work was undertaken after the 2003 sampling period. A more detailed description of habitat modifications in Drapers Creek is described in Yagi, 2006. Fisheries sampling in 2003 included 7 stations covering the lower mid and upper reaches (Figure 43). Repeat sampling in 2004, 2006 and 2007 re-sampled 2 stations in the midwater and 1 near the mouth. Sampling at the repeat stations involves a mix of seining and backpack electrofishing.

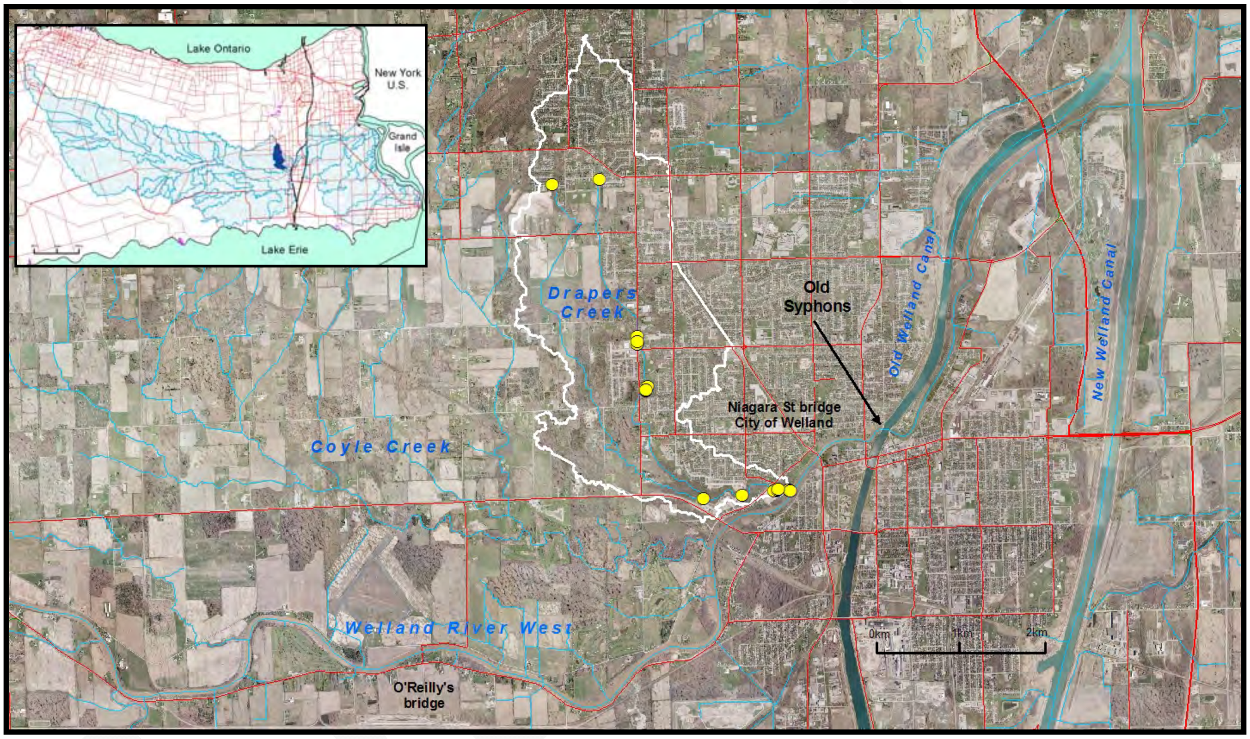


Figure 43 Drapers Creek Sampling Locations

There are no historic records for Drapers Creek. Results for all survey periods are presented in Table 27 as relative abundance. All 22 species recorded from Drapers Creek are commonly found in the Welland River tributaries except rosyface shiner and brook stickleback. Rosyface shiner, a lithophillic species, was found near the creek mouth in 2003 (1.4%) and not found in the subsequent two re-sampling periods at that station. Within the Upper Niagara River watershed rosyface shiner has been found incidentally in Coyle Creek and Biederman Drain near the Wainfleet Bog. Brook stickleback is a species associated with cold groundwater fed streams. Repeat sampling in 2006 and 2007 appears to indicate movement to downstream areas subsequent to the 2003 sampling, when it was only found in the headwater stations. This downstream shift is attributed to the restoration work done after 2003 that created a better flowing creek system with less large warm pools. An increase in creek chub in the lower part of the river is also attributed to this change in creek characteristics. Other species in the downstream reaches in the 2006 & 2007 sampling not present in 2003 include golden shiner, fathead minnow, rock bass and blue gill. Native species not captured with repeat sampling are black bullhead, northern pike and black crappie. The 3 exotic species found in 2003, gizzard shad. common carp and goldfish were not recaptured in 2007 or 2009.

Largemouth bass and northern pike in Drapers Creek captured upstream of the station at the mouth are all YOY indicating use of the stream for spawning and rearing. Some of these will shift to a piscivorous diet while in the creek, but otherwise resident top predators are absent in repeat sampling. Grass pickerel may be a suitable introduction as a resident top predator. Top predators such as large pike have been collected from the station at the mouth of the creek. The white sucker collected at the mouth of the creek in 2009 was an adult and the first occurrence of white sucker in Drapers Creek. Restoration in the creek may result in future spawning opportunities for this species.

The Fish Community monitoring with repeat stations indicates a higher relative abundance in 2006 and 2007 compared to pre restoration project sampling in 2003 and 2005 (Figure 44). The increase in abundance is attributed to higher number of brook stickleback, a resident (endogenous) fish species and not a higher number of exogenous or migratory species. The increase may be associated with a natural channel restoration project upstream within Maple Park.

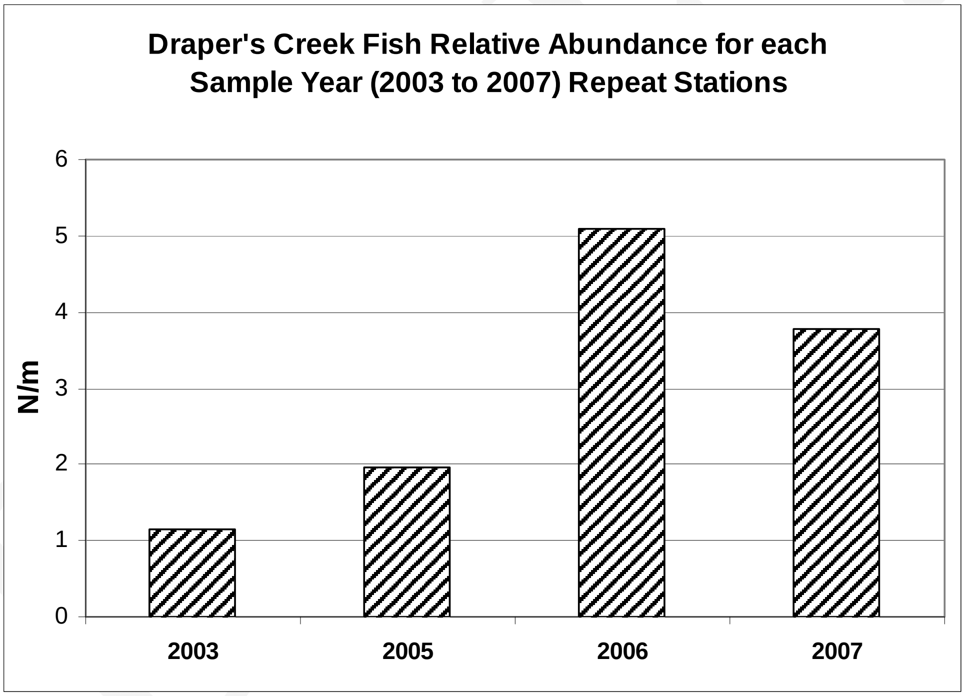


**Figure 44 Fish Community Monitoring of Repeat Stations over a five year period**.

## Drapers Creek Summary

| | |
|---|---|
| Summer Flow regime: | 6.1km permanent residual summer habitat, remnant pool habitat in headwaters 1.8ha. |
| Historic Data: | No Historic data |
| Restorative Work | Restoration work done to culvert at Colbeck Drive and re-establish riparian buffers in the midwater, and increase habitat structure and control erosion near the mouth. |
| Habitat | High to low gradient wetland stream, clay substrate, sparse rock, rubble, gravel & loose fines in the lower reaches. Changes to more coarse material (sand and gravel) toward moraine. Instream vegetation is sparse in the lower reaches and increases upstream. |
| Fish Community Objectives: | • Maintain base flow and increase coldwater habitat zone in headwaters<br>• Increase resident minnow species diversity from 5 to > 8<br>• Increase resident sucker species diversity from 0 to 2 or more<br>• Increase abundance of resident piscivorous species<br>• Explore feasibility of reintroducing Grass Pickerel |
| Top 3 Manangement Recommendations: | 1. Expand restoration project to include wetland marsh estuary from Colbeck Drive downstream to river interface<br>2. Improve riparian width throughout watershed<br>3. Increase substrate diversity in higher gradient reaches using natural channel design |

### Table 27 Species Presence and Relative Abundance Drapers Creek

| COSEWIC | Common Name | Scientific Name | 2009 Oct 2stns | Repeat stns (1,4,5) 2007 oct | 2006 Jul | 2003 Sep | 2003 Sep 7stns | ROM or MNR |
|---|---|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | + |
| | Central Mudminnow | *Umbra limi* | | 0.6% | 0.1% | 0.8% | 1.1% | |
| | White Sucker | *Catostomus commersoni* | 0.7% | | | | | |
| | Black Bullhead | *Ameiurus melas* | | | | 0.7% | 0.5% | |
| | Brown Bullhead | *Ameiurus nebulosus* | | | 0.3% | 4.0% | 2.8% | |
| | Tadpole Madtom | *Noturus gyrinus* | | 0.4% | 0.3% | 11.4% | 8.1% | |
| | Brook Stickleback | *Culaea inconstans* | | 29.9% | 43.6% | | 1.9% | |
| | Johnny Darter | *Etheostoma nigrum* | | 2.0% | 3.0% | 0.7% | 3.2% | |
| | Golden Shiner | *Notemigonus crysoleucas* | | 0.6% | 0.4% | | | |
| | Rosyface Shiner | *Notropis rubellus* | | | | 2.0% | 1.4% | |
| | Bluntnose Minnow | *Pimephales notatus* | 2.4% | 0.2% | 0.4% | 3.4% | 2.6% | |
| | Fathead Minnow | *Pimephales promelas* | | 1.8% | 0.7% | | | |
| | Creek Chub | *Semotilus atromaculatus* | | 17.3% | 29.7% | 2.4% | 12.5% | |
| | Rock Bass | *Ambloplites rupestris* | | 0.6% | | | | |
| | Green Sunfish | *Lepomis cyanellus* | 16.8% | 6.7% | 7.3% | 10.3% | 18.5% | |
| | Pumpkinseed | *Lepomis gibbosus* | 56.2% | 14.3% | 8.8% | 55.6% | 41.6% | |
| | Bluegill | *Lepomis macrochirus* | 0.8% | 21.8% | 2.4% | | | |
| | sunfish | *Lepomis* sp. | | | 1.4% | | | |
| | Northern Pike | *Esox lucius* | 3.0% | | | 1.9% | 1.3% | |
| | Largemouth Bass | *Micropterus salmoides* | 0.8% | 1.6% | 0.3% | 1.3% | 0.9% | |
| | Black Crappie | *Pomoxis nigromaculatus* | 1.4% | | | 0.7% | 0.5% | |
| | Yellow Perch | *Perca flavescens* | 17.8% | 2.0% | 1.3% | 1.3% | 0.9% | |
| | Gizzard Shad | *Dorosoma cepedianum* | | | | 2.0% | 1.4% | |
| | Goldfish | *Carassius auratus* | | | | 0.7% | 0.5% | |
| | Common Carp | *Cyprinus carpio* | | | 0.1% | 0.7% | 0.5% | |
| | *#SPECIES* | 25 | 9 | 14 | 15 | 17 | 18 | 1 |
| | *#fish caught* | | 129 | 491 | 764 | 188 | 301 | |

Legend for Table 61

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | ▨ | Sucker family |
| 🟨 | Sunfish family (other than sportfish) | 🟦 | Exotic species, including exotic sportfish |
| 🟧 | Native sportfish | | |

## Coyle Creek

Coyle Creek is the next tributary west of Drapers Creek and the eastern most tributaries also originate from groundwater discharge at the Fonthill Kame Moraine. Unlike Drapers Creek, groundwater supply to Coyle Creek is not sufficient to maintain flow year round so precipitation plays a greater roll in extent of summer habitat. During periods of low precipitation parts of Coyle Creek dry out. Restoration efforts include projects to remove a dam and create a riffle pool sequence, established a riparian community along some reaches of the creek, and recreate a meander configuration in previously straightened reaches (Yagi, 2006). There are no historic records for Coyle Creek other than presence/absence data from 1991. The first MNR sampling in 2004 included 6 stations covering the lower, mid and upper reaches. Repeat sampling in 2005 and 2007 re-sampled the station closest to the mouth by seine netting. Sampling in 2006 & 2009 covered the mid and upstream reaches to see any effects of the dam removal and included a mix of seining and backpack electrofishing.

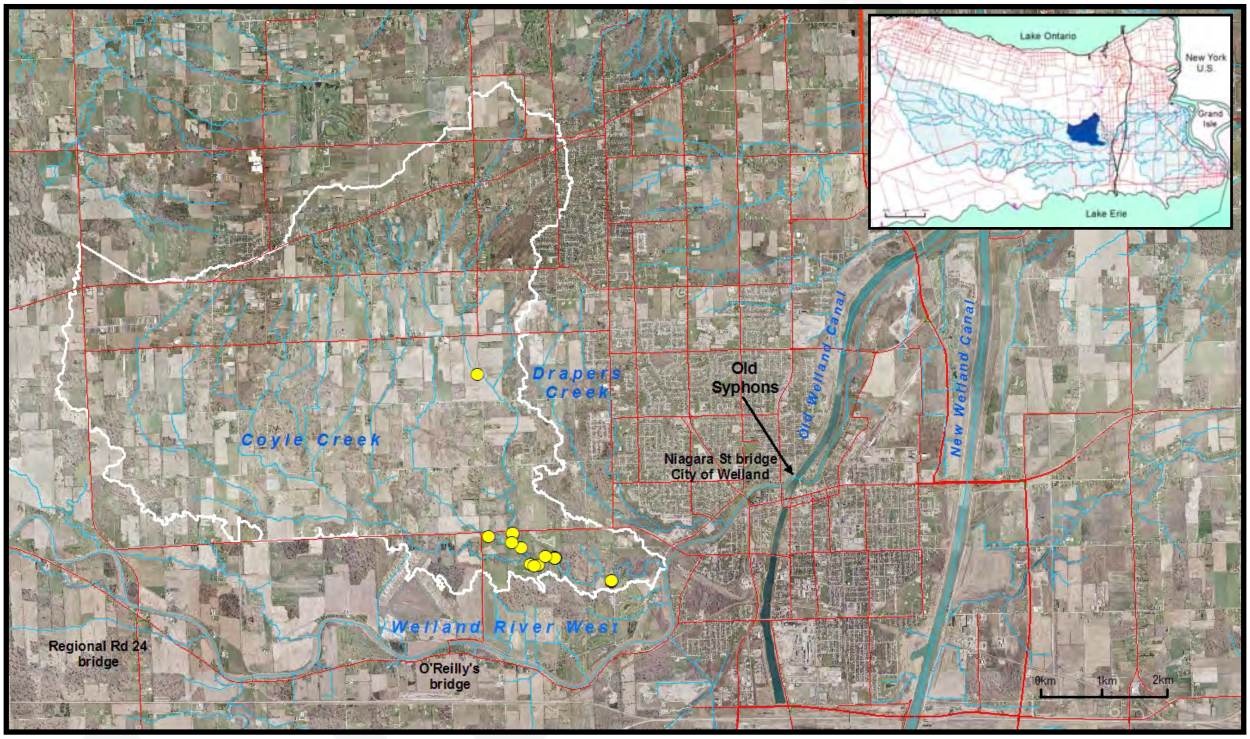


Figure 45 Coyle Creek Sampling Locations

Table 28 lists the 30 species recorded from Coyle Creek and their relative abundance showing all common native species and 3 exotics; white perch, common carp and goldfish. Species collected historically were recaptured in recent surveys. Black bullhead and brook stickleback are species collected from the headwaters and not expected to be found at the repeat station. Rosyface shiner is an uncommon minnow, only found in Drapers and Coyle Creek in recent sampling in the Niagara River watershed. Bluegill was absent from the repeat station in 2004 and became the most abundant species in both 2005 (49%) and 2006 (68%). Largemouth bass in Coyle Creek are generally YOY, but include a few larger piscivorous juveniles. Northern pike are all larger individuals and the absence of YOY in the creek suggests use of the creek for feeding only. White sucker collected in 2006 and 2009 included schools of YOY as well as older individuals. White sucker collected from 2004 were not YOY. The 2006 surveys upstream and down stream of the project site showed presence of grass pickerel and white sucker resident behind the riffle structure. In addition, on May 6th, 2008 a sucker spawning run was observed in the constructed riffle areas (A.Yagi, pers. obsv.).

## Table 28 Species Presence and Relative Abundance Coyle Creek

| COS EWIC | Common Name | Scientific Name | 2009 Aug 5stns | 2006 Jul 4stns | 2004 Jun & Sep 6stns | 2007 Oct | Stn 1 2005 Sep | 2004 Jun | 1991 (Ecologistic) |
|---|---|---|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americana vermiculauts* | | 0.7% | | | | | |
| | Central Mudminnow | *Umbra limi* | 0.5% | 5.2% | 8.3% | | | 0.8% | |
| | White sucker | *Catostomus commersoni* | 1.9% | 1.5% | 0.4% | | 0.1% | | |
| | Black Bullhead | *Ameiurus melas* | | | 0.5% | | | | |
| | Yellow Bullhead | *Ameiurus natalis* | | 0.5% | 0.1% | 0.2% | | 0.8% | |
| | Brown Bullhead | *Ameiurus nebulosus* | 1.7% | 2.2% | 6.0% | 0.4% | 3.8% | 6.9% | + |
| | Channel Catfish | *Ictalurus punctatus* | | | 0.1% | | 0.1% | 0.8% | |
| | Tadpole Madtom | *Noturus gyrinus* | 1.6% | 0.1% | 7.8% | 0.7% | 2.0% | 24.4% | |
| | Brook stickleback | *Culaea inconstans* | 1.0% | | 6.1% | | | | |
| | Johnny Darter | *Etheostoma nigrum* | 16.5% | 6.1% | 5.6% | 3.0% | 0.7% | 0.8% | + |
| | Logperch | *Percina caprodes* | | 0.2% | | | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 9.6% | 0.7% | 0.3% | 2.8% | 4.1% | 4.6% | |
| | Common Shiner | *Luxilus cornutus* | <0.1% | | | | | | |
| | Rosyface Shiner | *Notropis rubellus* | | | 0.2% | | | 2.3% | |
| | Bluntnose Minnow | *Pimephales notatus* | 21.5% | 14.4% | 28.3% | 1.8% | 1.8% | 8.4% | + |
| | Fathead Minnow | *Pimephales promelas* | | 0.9% | 2.0% | | | 1.5% | |
| | Creek Chub | *Semotilus atromaculatus* | | | 0.1% | | | 1.5% | + |
| | Rock Bass | *Ambloplites rupestris* | | | 0.1% | | | 0.8% | |
| | Green Sunfish | *Lepomis cyanellus* | 15.6% | 32.3% | 28.3% | 1.0% | 4.5% | 18.3% | |
| | Pumpkinseed | *Lepomis gibbosus* | 9.2% | 19.1% | 4.8% | 17.8% | 23.0% | 19.8% | + |
| | Bluegill | *Lepomis macrochirus* | 3.6% | 8.6% | 0.1% | 68.1% | 49.0% | | |
| | sunfish | *Lepomis* sp. | 2.8% | | | 0.1% | 0.4% | | |
| | Northern Pike | *Esox lucius* | 0.2% | | 0.1% | | 0.1% | 0.8% | |
| | Largemouth Bass | *Micropterus salmoides* | 8.5% | 4.3% | 0.4% | 1.2% | 0.4% | 0.8% | + |
| | White Crappie | *Pomoxis annularis* | 4.5% | 0.3% | | | 0.4% | | |
| | Black Crappie | *Pomoxis nigromaculatus* | | | 0.2% | 0.1% | 0.4% | 2.3% | + |
| | Yellow Perch | *Perca flavescens* | 0.8% | 1.1% | 0.3% | 2.1% | 8.6% | 3.8% | + |
| | White Perch | *Morone americana* | 0.2% | | 0.1% | 0.6% | | 0.8% | + |
| | Goldfish | *Cassius auratus* | | 0.5% | | | | | |
| | Common Carp | *Cyprinus carpio* | 0.2% | 1.4% | 0.2% | | 0.4% | | |
| | *#SPECIES* | 30 | 19 | 19 | 24 | 13 | 17 | 19 | 9 |
| | *#fish caught* | | | | 1797 | 822 | 732 | 131 | |

Legend for Table 28

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, including exotic sportfish |
| 🟨 | Sunfish family (other than sportfish) | ▨ | Sucker family |
| 🟧 | Native sportfish | SC | Special Concern |

## Coyle Creek Summary

| | |
|---|---|
| Summer Flow regime: | 4.37km permanent summer habitat, remnant pool habitat in headwaters, 1.23ha. |
| Historic Data: | Ecologistics, 1991 |
| Restorative Work | Winter 2006 remove dam, establish riparian edge, recreate meander configuration (previously straightened). Restoration work is incomplete. |
| Habitat | Moderate-low gradient, clay, sparse rock, rubble, gravel, pockets of loose fines in lower reaches. Coarse material (gravel) toward the moraine. Instream vegetation absent in lower reaches and increases to sparse coverage upstream. |
| Fish Community Objectives: | • Increase resident minnow species diversity from 6 to > 8<br>• Increase sucker species diversity from 1 to 2 or more<br>• Increase abundance of resident sport fish species to >10% |
| Top 3 Manangement Recommendations: | 1. Create wetland marsh estuary from Pelham Rd to river interface<br>2. Improve riparian buffer width and quality in watershed<br>3. Increase substrate diversity in higher gradient reaches using natural channel design |

## Big Forks Creek

Big Forks Creek has wet habitat as far as 12.62km upstream of the mouth, but field investigation has not been done to determine if this is continuous or intermittent habitat. Sampling covered 3 stations in 2004 (Figure 46). There are no historic records for the creek and no repeat sampling has been done. Branches of Big Forks Creek classified as municipal drains were also sampled in 2008 & 2009 including Beezor Drain, North Forks Drain, East Kelly Drain, Mill Race Creek and Wolf Creek Drain. Two other drains of Big Forks Creek were investigated in 2008 (Ellsworth and South Forks) however, absence of residual summer habitat precluded sampling. There are no historic fisheries records for the drains so sampling attempted to survey all available habitat types.

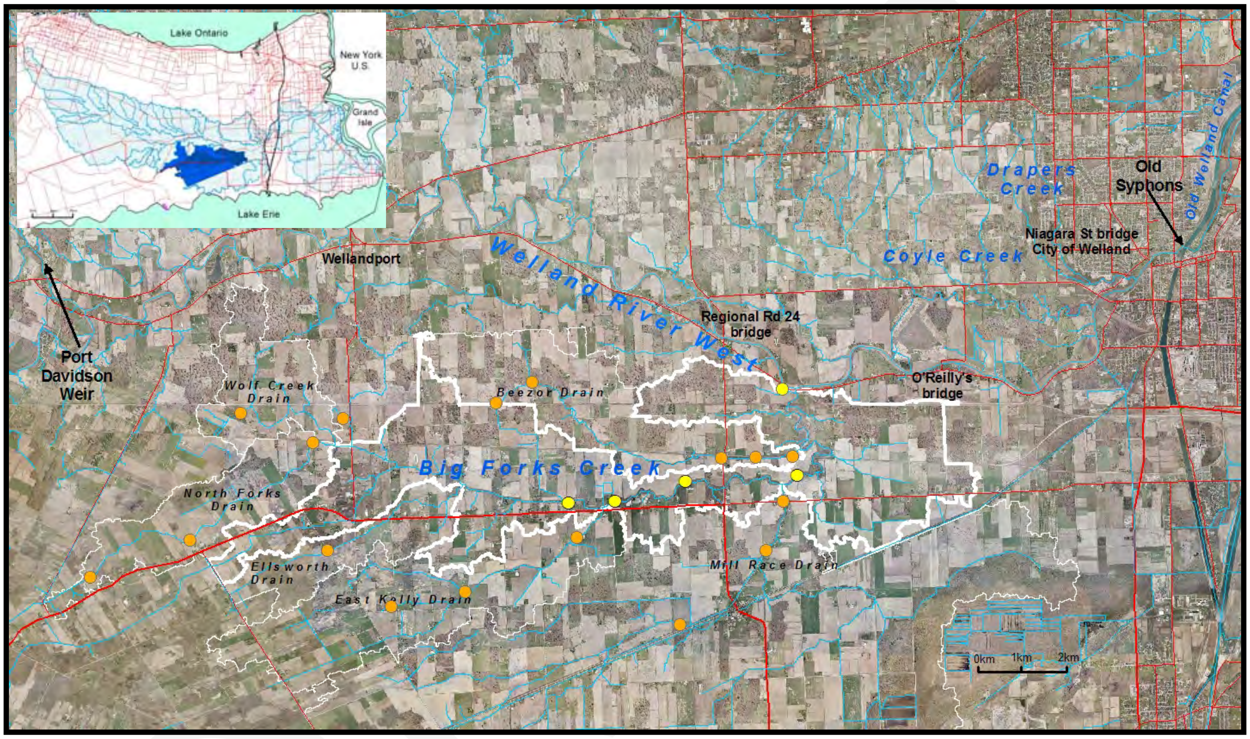


**Figure 46 Big Forks Creek Sampling Locations**

Table 29 gives the relative abundance of the 24 species collected from the watershed, which are all common species and include 3 exotic species; white perch, common carp and goldfish. Presence of brook stickleback, found at the most upstream station in Big Forks Creek, is an indication of groundwater upwelling in that area. Substrate at that station is composed of 100% loose muck with moderate instream vegetation (*Elodea* sp. and milfoil). Immediate banks are shallow and soft with dense herbaceous riparian cover. White perch, found historically in Big Forks Creek was not collected in the recent survey. Yellow bullhead was collected historically from North Forks Drain, a tributary of Big Forks Creek. Pike collected in Big Forks Creek included atleast 4 age classes (total length 185 – 402mm).

The reaches classified as drains show greatest abundance of sunfishes and central mudminnows, but of significance was the collection from Mill Race Creek Drain of grass pickerel (COSWIC-Special Concern). Also the presence of YOY largemouth bass and northern pike from most of the drains indicate that these shallow, vegetated drains provide spring spawning habitat for larger predatory species. Freshwater Drum found in Mill Race Creek is uncommon in tributary habitat may be the result of bait bucker transfer. The drains may be subject to dredging as was evident in the summer of 2008 when at the time of sampling a large section of Wolfe Creek Drain had been dredged on both sides of Wainfleet-Dunnville Townline. Dredging removed all available instream cover and sampling recovered no fish. Two other stations that were not dredged surveyed on Wolfe Creek Drain included capture of YOY and adult northern pike.

**Table 29 Species Relative Abundance Big Forks Creek & Drain branches**

| COSEWIC | Common Name | Scientific Name | Wolf Creek Drain 3stns | East Kelly Drain 3stns | North Forks Drain 3stns | Beezor Drain 3stns | | Mill Race Creek Drain 3stns | Big Forks Creek 3stns | MNR |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2008 Nov | 2008 Sep | 2008 Sep | 2009 Oct/Nov | 2008 Sep | 2004 Jul/Aug | 2004 Jul Sep Oct | 1976 |
| | Bowfin | *Amia calva* | | | | | | | 0.1% | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | | | 0.2% | | |
| | Central Mudminnow | *Umbra limi* | 72.70% | | 86.60% | 36.2% | 3.1% | 5.3% | 1.5% | |
| | Black Bullhead | *Ameiurus melas* | | | | | 1.0% | 2.2% | 0.1% | |
| | Yellow Bullhead | *Ameiurus natalis* | | | | | | | | + |
| | Brown Bullhead | *Ameiurus nebulosus* | | | | 1.7% | 9.2% | 17.8% | 5.4% | |
| | Bullhead sp. | *Ameiurus* sp. | | | | | | 0.9% | | |
| | Tadpole Madtom | *Noturus gyrinus* | | | | | | 6.2% | 9.6% | |
| | Brook stickleback | *Culaea inconstans* | | | | | | | 0.1% | |
| | Johnny Darter | *Etheostoma nigrum* | | 5.0% | | 27.3% | | 1.6% | 2.6% | |
| | Freshwater Drum | *Aplodinotus grunniens* | | | | | | 0.4% | | |
| | Logperch | *Percina caprodes* | | | | | | | 2.4% | |
| | Golden Shiner | *Notemigonus crysoleucas* | | | | 0.8% | | 8.2% | 6.0% | |
| | Bluntnose Minnow | *Pimephales notatus* | | | | | 2.0% | | 0.6% | |
| | Fathead Minnow | *Pimephales promelas* | | 87.5% | | | | 0.7% | | |
| | Green Sunfish | *Lepomis cyanellus* | 9.10% | 2.5% | | 2.5% | 31.6% | 25.6% | 7.0% | |
| | Pumpkinseed | *Lepomis gibbosus* | | | 6.30% | 30.7% | 23.5% | 24.9% | 60.9% | + |
| | Bluegill | *Lepomis macrochirus* | | | | | 5.1% | | 1.2% | |
| | YOY Sunfish | *Lepomis sp.* | | | 1.60% | | 7.1% | | | |
| | Northern Pike | *Esox lucius* | 18.20% | 2.5% | 0.80% | | 7.1% | 0.7% | 1.0% | |
| | Largemouth Bass | *Micropterus salmoides* | | 2.5% | | 0.8% | 10.2% | 0.2% | 0.1% | |
| | White Crappie | *Pomoxis annularis* | | | | | | 2.4% | 0.3% | |
| | Black Crappie | *Pomoxis nigromaculatus* | | | | | | 0.4% | 1.9% | |
| | Yellow Perch | *Perca flavescens* | | | | | | | 1.0% | |
| | White Perch | *Morone americana* | | | | | | | | + |
| | goldfish | *Carassius auratus* | | | | | | | 0.4% | |
| | Common Carp | *Cyprinus carpio* | | | 4.70% | | | 1.3% | | |
| | *#SPECIES* | *24* | 3 | 5 | 5 | 7 | 10 | 17 | 19 | 3 |
| | *# fish caught* | | 11 | 40 | 127 | 123 | 98 | 449 | 686 | |

Legend for Table 29

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, including exotic sportfish |
| 🟨 | Sunfish family (other than sportfish) | 🟧 | Native sportfish |

### Big Forks Creek Summary

| | |
|---|---|
| Summer Flow regime: | 12.62km of residual summer habitat, 1.23ha. |
| Historic Data: | MNR 1976 records for Big Forks Creek and North Forks Creek |
| Restorative Work: | No known projects, headwaters are municipal drains |
| Habitat: | Low gradient wetland stream with backwater from Welland River, clay substrate with areas of loose mucky fines in the lower reaches with no instream vegetation. More loose muck in upper reaches and sparse to moderate instream vegetation. |
| Fish Community Objectives: | • Increase # resident minnow species to > 5<br>• Maintain current level of connectivity to Welland River<br>• Increase abundance of resident intolerant fish species to >50%<br>• Increase abundance of resident sport fish species to >10% |
| Top 3 Manangement Recommendations: | • Increase marsh wetland size and quality at main river interface / estuary<br>• Improve riparian buffer width and quality in watershed<br>• Discuss Drain design alternatives with municipality to improve insteam habitat (woody material, submergent plants) |

### Mill Race Creek

| | |
|---|---|
| Summer Flow regime: | Permanent flow, 4.96km of residual summer habitat, 3.79 ha |
| Historic Data: | No Historic data |
| Restorative Work | No known projects however frequent drainage clean outs evident and channelization (straightened). |
| Habitat | Low gradient wetland stream, loose silt and clay substrate, water colour yellow-brown with little to no instream cover except in the mid reach there was coarser substrate (rubble and boulder). Feeder canal may impact connectivity. |
| Fish Community Objectives: | • Maintain or improve habitat to support Grass Pickerel<br>• Maintain current level of connectivity to Welland River<br>• Increase resident minnow species diversity to > 5<br>• Increase abundance of resident intolerant fish species to >50%<br>• Increase abundance of resident sport fish species to >10% |
| Top 3 Manangement Recommendations: | 1.Increase stream wetland habitat(woody material, submergent plants)<br>2. Improve riparian buffer width and quality in watershed<br>3. Determine whether the Feeder Canal is a fish barrier consider mitigation of movement using riffle structure instead of removal to ensure recovery objectives for grass pickerel are met. |

### Beezor Drain Summary

| | |
|---|---|
| Summer Flow regime: | 11.6 km of intermitted habitat, with residual summer habitat restricted to mouth<br>No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Predominately clay substrate with mixture of sparse rock, muck and loose fines. Moderate emergent, floating and submergent vegetation (algae, duckweed, cattail). Runs through planted agricultural fields and dense woodlots |

### North Forks Drain Summary

| | |
|---|---|
| Summer Flow regime: | 9.5 km of intermitted habitat, seasonal flow pptn driven with some groundwater from adjacent drained fields<br>No known migration barriers |
| Historic Data: | MNR 1976 records for North Forks Creek |
| Restorative Work | No known projects. |
| Habitat | 100% flats with predominantly soft clay substrate. Moderate to dense emergent, floating and submergent vegetation. Entire surface of water covered by duckweed throughout lower and mid reach. |

### East Kelly Drain Summary

| | |
|---|---|
| Summer Flow regime: | 19.3 km of intermitted drain, seasonal flow<br>No known migration barriers. |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Hard clay substrate throughout, with small pockets of rocks and boulders under bridge. Mixtures of lose silt and fines in upstream stations. Sparse to moderate in stream cover with submergent and emergent vegetation increasing in density upstream (algae, cattails). Deeper pools remain under road culverts. |

### Wolfe Creek Drain Summary

| | |
|---|---|
| Summer Flow regime: | 13.5 km of intermitted drain, seasonal flow, residual habitat in lower reach<br>No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Man-made drainage channel in clay substrate with loose mucky fines. Approximately, 200m of drain on both sides of Wainfleet/ Dunnville Townline devoid of in stream cover after late summer dredging in 2008. |

## Little Forks Creek

The first sampling of Little Forks Creek was done in August of 2009 at one station using a backpack electrofishing unit. Standard sampling of a 50m reach of the creek collected only 2 central mudminnows (3 runs, total of 1371ES). Field notes indicate a strong smell of manure in the water and that approximately 100 brown bullheads were observed gasping for air at the next downstream road crossing culvert. Field notes also indicate there was no flow at the time of the sampling and that instream cover was moderate to abundant with emergent vegetation.

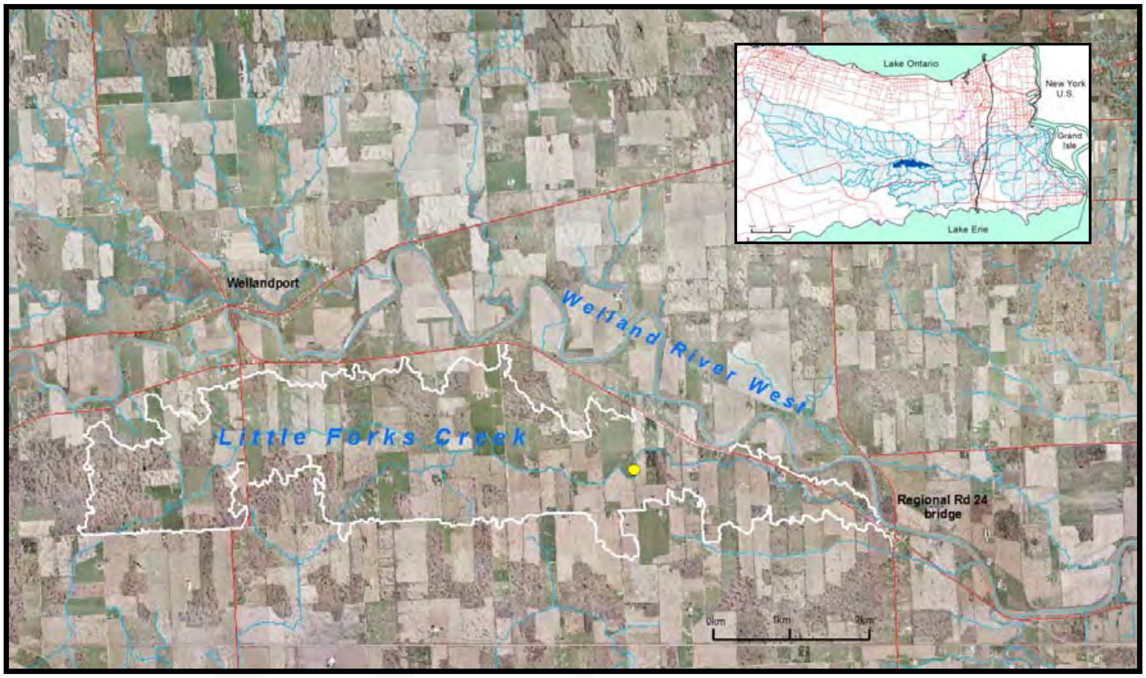


**Figure 47 Little Forks creek Sampling Locations**

**Table 30 Species Relative Abundance for Little Forks Creek**

| Common Name | Scientific Name | 2009<br>1 stns |
|---|---|---|
| Central Mudminnow | *Umbra limi* | 100% |
| *#SPECIES* | 1 | 1 |
| *#fish caught* | | 2 |

**Little Forks Creek**

| | |
|---|---|
| Summer Flow regime: | Unknown |
| Historic Data: | No Historic data |
| Restorative Work | No known projects. |
| Habitat | Low gradient wetland stream with moderate to abundant emergent vegetation and overhanging grasses |
| Fish Community Objectives: | Need to resample to better understand hydrology and fish community potential. Drainage work may limit overall success of instream projects. Habitat indicates suitability for minnows and possibly grass pickerel |
| Top Manangement Recommendations: | Talk to local landowners about the creek water quality.<br>Improve buffer width through areas with no buffer at this time. |

## The Old Feeder Canal

Four stations sampled in 2009 used a combination of boat electrofishing, backpack electrofishing, and seine netting, and collected 17 species (Figure 48 and Table 31). The largemouth bass and northern pike were juvenile, of the size to be piscivorous. Exotic goldfish represent more than half the fish collected. Habitat in the Old Canal ranges from deeper, still areas covered with lily and emergent aquatic vegetation to runs and riffles of larger coarse substrate material (up to boulder). Some species partitioning was apparent with goldfish, bullheads, yellow perch, crappie, golden shiner and most of the sunfishes inhabiting the slow deeper pools. Johnny darter, creek chub and northern pike were associated with the shallower faster flowing stations.

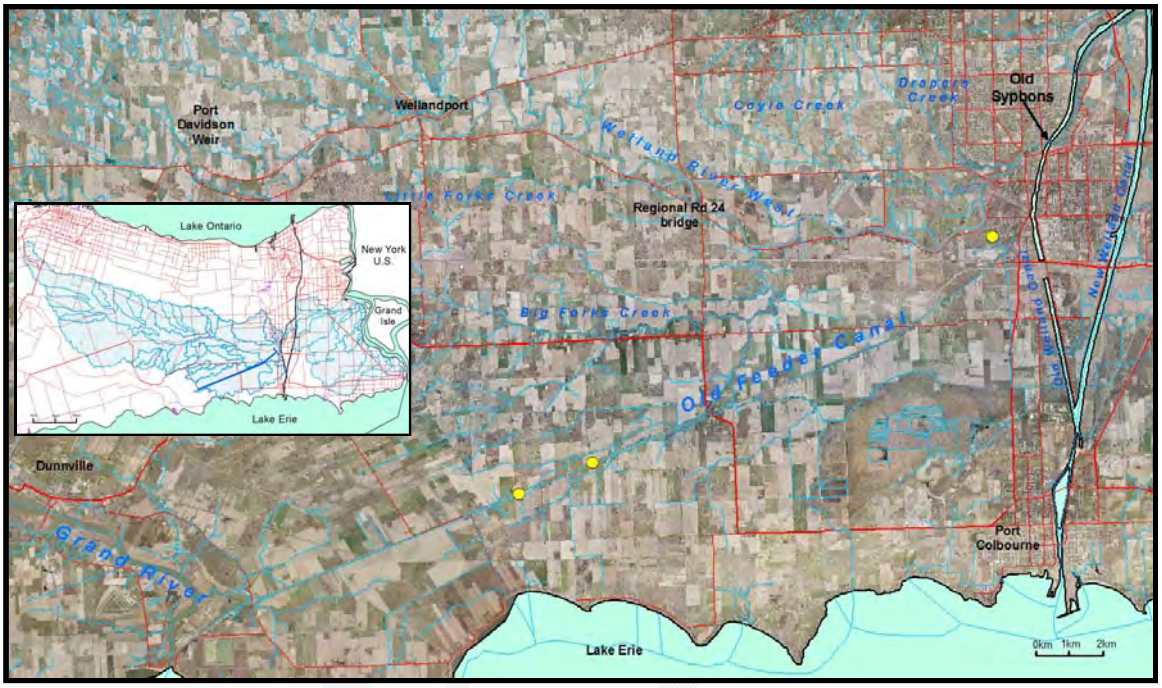


Figure 48 Old Feeder Canal Sampling Locations

**Table 31 Fish Species Relative Abundance for The Old Feeder Canal**

| Common Name | Scientific Name | 2009 4 stns |
|---|---|---|
| Central Mudminnow | *Umbra limi* | 2.7% |
| Black Bullhead | *Ameiurus melas* | 1.4% |
| Brown Bullhead | *Ameiurus nebulosus* | 1.3% |
| Tadpole Madtom | *Noturus gyrinus* | 0.7% |
| Johnny Darter | *Etheostoma nigrum* | 2.9% |
| Golden Shiner | *Notemigonus crysoleucas* | 10.1% |
| Bluntnose Minnow | *Pimephales notatus* | 3.5% |
| Fathead Minnow | *Pimephales promelas* | 0.5% |
| Creek Chub | *Semotilus atromaculatus* | 0.4% |
| Green Sunfish | *Lepomis cyanellus* | 13.2% |
| Pumpkinseed | *Lepomis gibbosus* | 3.5% |
| Bluegill | *Lepomis macrochirus* | 0.4% |
| Northern Pike | *Esox lucius* | 0.5% |
| Largemouth Bass | *Micropterus salmoides* | 0.6% |
| White Crappie | *Pomoxis annularis* | 1.1% |
| Yellow Perch | *Perca flavescens* | 1.6% |
| Goldfish | *Carassius auratus* | 55.0% |
| *#SPECIES* | 17 | 17 |
| *#fish caught* | | 546 |

| | LEGEND for Table 30 |
|---|---|
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |

## Biederman Drain (including Wainfleet Bog Drains)

The Wainfleet Bog drains are a grid of interconnected man made channels created to enhance drainage for historic peat extraction. The drains intercept groundwater from the bog interior and also carry overland runoff. The grid of drains provides approximately 25.5 km of intermittant habitat, with permanent habitat restricted to deeper branches that continue to intercept the groundwater table in the dry seasons. The Biederman Drain is the outflow channel from the Wainfleet Bog that flows easterly to eventually connect with both the New Welland shipping Canal and the Old Feeder Canal. Water in this system is permanently stained appearing tea colored indicating the origin of water is from the Wainfleet bog. Two stations were seined in 2008 and several sites were electorfished in 2004 and minnow trapped in 2000 (Figure 49). In 2008 there was very low residual water in the drain near the Old Welland Canal therefore excluded sampling at that location, but sampling in the drain closer to the bog collected 20 central mudminnow and 1 grass pickerel (COSEWIC - Special Concern). Backpack electrofishing in Biederman Drain near the bog in 2004 found brown and black bullhead, tadpole madtoms, green sunfish and pumpkinseed as well as central mudminnows and grass pickerel. Minnow trap studies in August 2000 collected central mudminnow, northern pike (size not recorded), pumpkinseed and brown bullhead in the drain where it leaves the Wainfleet Bog, and central mudminnow, grass pickerel and pumpkinseed from minnow traps set in the drain network within the Bog proper (Table 32). Habitat in the bog and the Biederman drains is characterized by dense instream mosses, emergent aquatic vegetation and organic substrate.

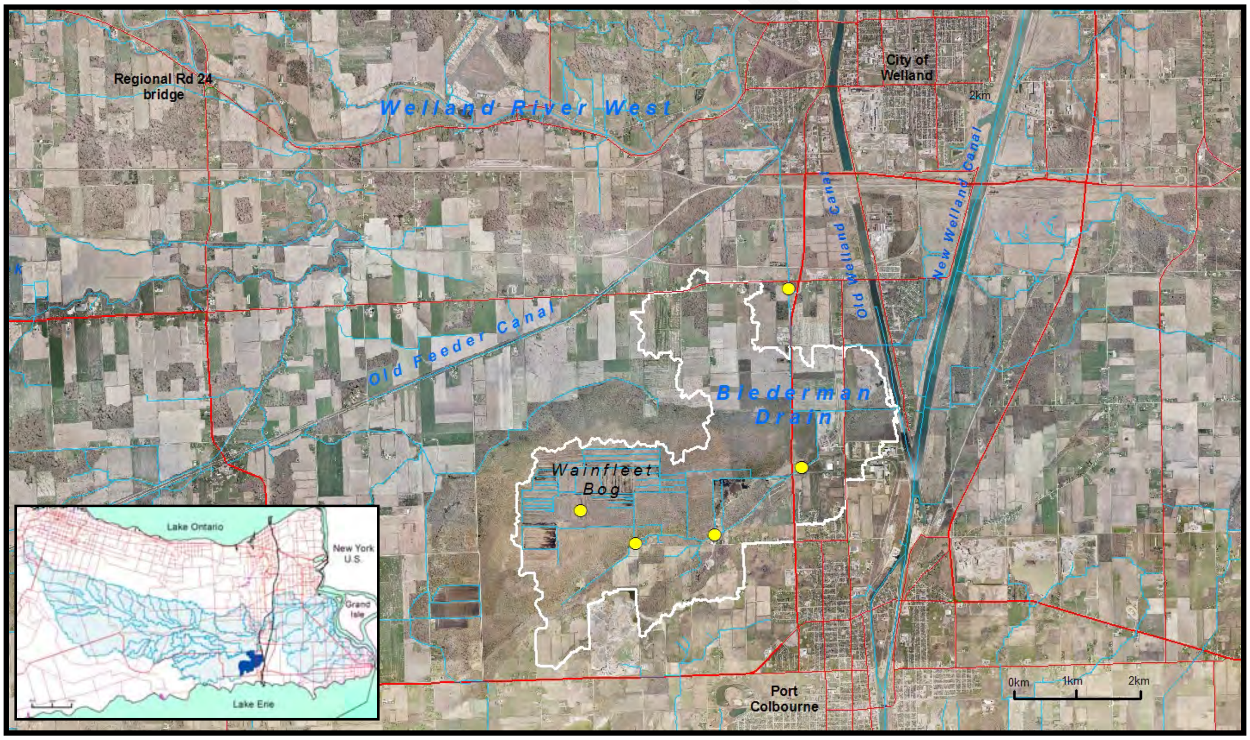


Figure 49 Biederman Drain sampling locations

## Table 32 Species Occurence from Biederman Drain & Wainfleet Bog

| COSEWIC | Common Name | Scientific Name | Biederman Drain 2008 Seine | Biederman Drain 2004 EF | Biederman Drain 2000 Minnow traps | Wainfleet Bog 2000 Minnow traps |
|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | + | + | | |
| | Central Mudminnow | *Umbra limi* | + | + | + | + |
| | Black Bullhead | *Ameiurus melas* | | + | | |
| | Brown Bullhead | *Ameiurus nebulosus* | | + | + | |
| | Tadpole Madtom | *Noturus gyrinus* | | + | | |
| | Green Sunfish | *Lepomis cyanellus* | | + | | |
| ` | Pumpkinseed | *Lepomis gibbosus* | | + | + | + |
| | Northern Pike | *Esox lucius* | | | + | |
| | *#SPECIES* | 8 | 2 | 7 | 4 | 3 |

## Biederman Drain Summary

| | |
|---|---|
| Summer Flow regime: | 25.5 km of intermitted habitat with permanent residual habitat found in groundwater discharge areas.<br>No known migration barriers although beaver dams are periodically present which help maintain water levels in the bog interior. |
| Historic Data: | 2000 and 2004 MNR Survey some limited ROM data |
| Restorative Work | Wainfleet Bog restoration underway in the bog interior to restore wetland and open water habitat. See NPCA for detials |
| Habitat | Very soft peat bottom with loose fines and inorganic detritus. Moderate instream cover of floating vegetation (algae mats and cattails), woody debris and undercut banks. |
| Manangement Recommendations: | Maintain or increase grass pickerel population. |

## Beaver Creek (West Lincoln)

Groundwater is associated with at least one of the tributaries of Beaver Creek, however sampling is minimal in this system due to lack of access on private lands. Historic sampling includes presence/absence data from 1988. Sampling in 2004 was possible at one station 10km above the creek mouth at the apparent limit of residual summer habitat for that year (Figure 50). Upstream of the sampling point, the creek channel was dry and had recently been dredged. In 2007, a very dry summer, repeat sampling at this location was not possible as the station and downstream channel were dry and cracked. Sampling was possible on two more of the tributaries in 2008, approximately 1.5 and 5km upstream of their confluence with Beaver Creek. Presence of brook stickleback indicates groundwater discharge in the tributary. Further sampling would better identify the range of groundwater inputs, as limited access has meant that sampling in the tributaries has only occurred at road crossings. In 2009, access was gained to sample near the mouth. The creek is wide enough at the mouth to require boat sampling and species are more representative of the larger open water habitat of the Welland River including gizzard shad, bowfin, black crappie and channel catfish.

Table 33 gives the relative abundance of 21 species caught in the creek, including grass pickerel (COSEWIC – Special Concern) and 3 exotics; gizzard shad, goldfish and common carp. Species caught in 1988 were all recaptured in 2004 or 2009 with the exception of Johnny darter. Largemouth bass collected from the mouth are both YOY and adults indicating the presence of habitat to support all life stages (spawning, rearing, juvenile and adult). Northern pike were of both juvenile and adult size near the mouth and juveniles in the upper reaches of the tributaries. Presence of grass pickerel at both the mouth and top end of the creek suggests more sampling needs to be done to better characterize the extent of use of the creek by this species. More sampling also would better identify what forage food sources in the creek support a relatively high abundance and diversity of piscivores (channel catfish, bowfin, largemouth bass, northern pike, grass pickerel).

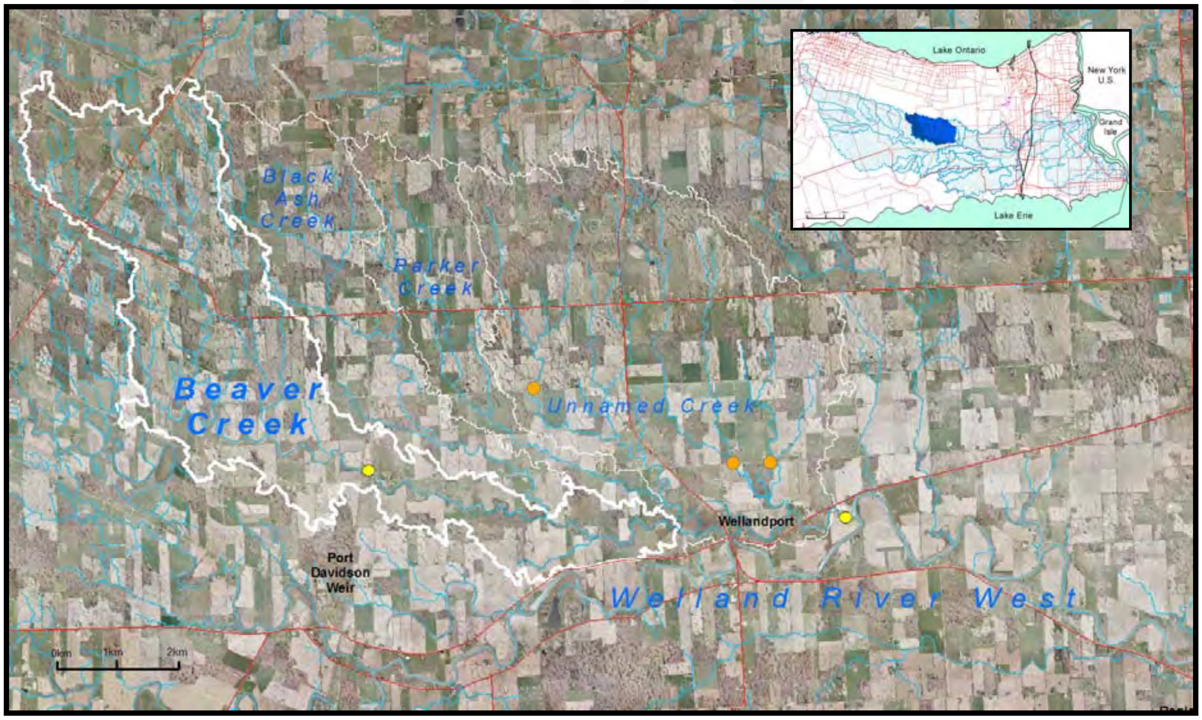


Figure 50 Beaver Creek (West Lincoln) Sampling Locations

## Table 33 Species Relative Abundance Beaver Creek

| COSE WIC | Common Name | Scientific Name | 2009 Oct 1 stn mouth | 2008 Oct 3 stns 3 tribs | 2004 Sep 1 stn top end | 1988 (Gartner Lee) |
|---|---|---|---|---|---|---|
| | Bowfin | *Amia calva* | 4.0% | | | |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 1.0% | | 0.2% | |
| | Central Mudminnow | *Umbra limi* | | 6.4% | | |
| | Black Bullhead | *Ameiurus melas* | | | 0.6% | |
| | Brown Bullhead | *Ameiurus nebulosus* | 1.0% | | 2.8% | + |
| | Channel Catfish | *Ictalurus punctatus* | 3.0% | | | |
| | Tadpole Madtom | *Noturus gyrinus* | | | 0.3% | |
| | Johnny Darter | *Etheostoma nigrum* | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 9.0% | 1.6% | 35.9% | |
| | Bluntnose Minnow | *Pimephales notatus* | | | 0.6% | |
| | Fathead Minnow | *Pimephales promelas* | | | 5.0% | |
| | Creek Chub | *Semotilus atromaculatus* | | 1.6% | | |
| | Brook Stickleback | *Culaea inconstans* | | 5.9% | | |
| | Green Sunfish | *Lepomis cyanellus* | 2.0% | 72.3% | 53.7% | + |
| | Pumpkinseed | *Lepomis gibbosus* | 18.0% | 9.6% | 0.2% | + |
| | Bluegill | *Lepomis macrochirus* | 12.0% | 0.5% | | |
| | sunfish | *Lepomis* sp. | | | 0.3% | |
| | Largemouth Bass | *Micropterus salmoides* | 14.0% | | | + |
| | Black Crappie | *Pomoxis annularis* | 14.0% | | | |
| | Northern Pike | *Esox lucius* | 2.0% | 1.6% | | |
| | Yellow Perch | *Perca flavescens* | 8.0% | | | + |
| | Gizzard Shad | *Dorosoma cepedianum* | 2.0% | | | |
| | Goldfish | *Carassius auratus* | | | 0.3% | |
| | Common Carp | *Cyprinus carpio* | 10.0% | 0.5% | | + |
| | *#SPECIES* | 23 | 14 | 9 | 11 | 7 |
| | #fish caught | | 93 | 188 | 616 | |

Legend for Table 32

| | |
|---|---|
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |

## Beaver Creek (West Lincoln) Summary

| | |
|---|---|
| Summer Flow regime: | 1.35km residual summer habitat-1.35ha and 1.83km permanent backwater habitat 4.2ha |
| Historic Data: | Historic data (Gartner Lee, 1988) |
| Restorative Work: | No known projects |
| Habitat: | Low gradient wetland stream. Soft clay substrate, sparse-dense instream vegetation & woody debris in lower reaches. Upper reaches flats, riffles & deeper pools with clay, gravel, cobble & loose fines. Moderate submergent, emergent and floating vegetation. |
| Fish Community Objectives: | • Increase # sampling stations<br>• Maintain or improve habitat to support Grass Pickerel<br>• Maintain current level of connectivity to Welland River<br>• Increase resident minnow species diversity to > 5<br>• Increase abundance of resident sport fish species to >10% |
| Top 3 Manangement Recommendations: | 1. Increase marsh wetland size and quality at main river interface / estuary<br>2. Improve riparian buffer width and quality in watershed<br>3. Improve insteam habitat (woody material, submergent plants) |

## Sucker Creek

There is no historic fisheries data for Sucker Creek. October 2008 surveys are the first data assessing 3 stations 1km, 2.5km and 5km upstream of the mouth (figure 51). The two lower stations had ‘slow’ flow and the most upstream station was described as having no flow and may be remant pool habitat within an intermittent reach. Habitat is described as riffle, run and pool at the most downstream station and pools and flats at the 2 upstream stations. Table 34 lists 12 species for Sucker Creek including three exotic species; gizzard shad, common carp and round goby. Largemouth bass found at the 2 lower stations are predominantly YOY, but include one year-1 individual. Schools of gizzard shad, golden shiners and bluntnose minnows were observed within the lower reach. Presence of round goby in Sucker Creek is the only occurrence of this exotic upstream of the Old Welland Canal and may possibly be from illegal bait bucket transfers.

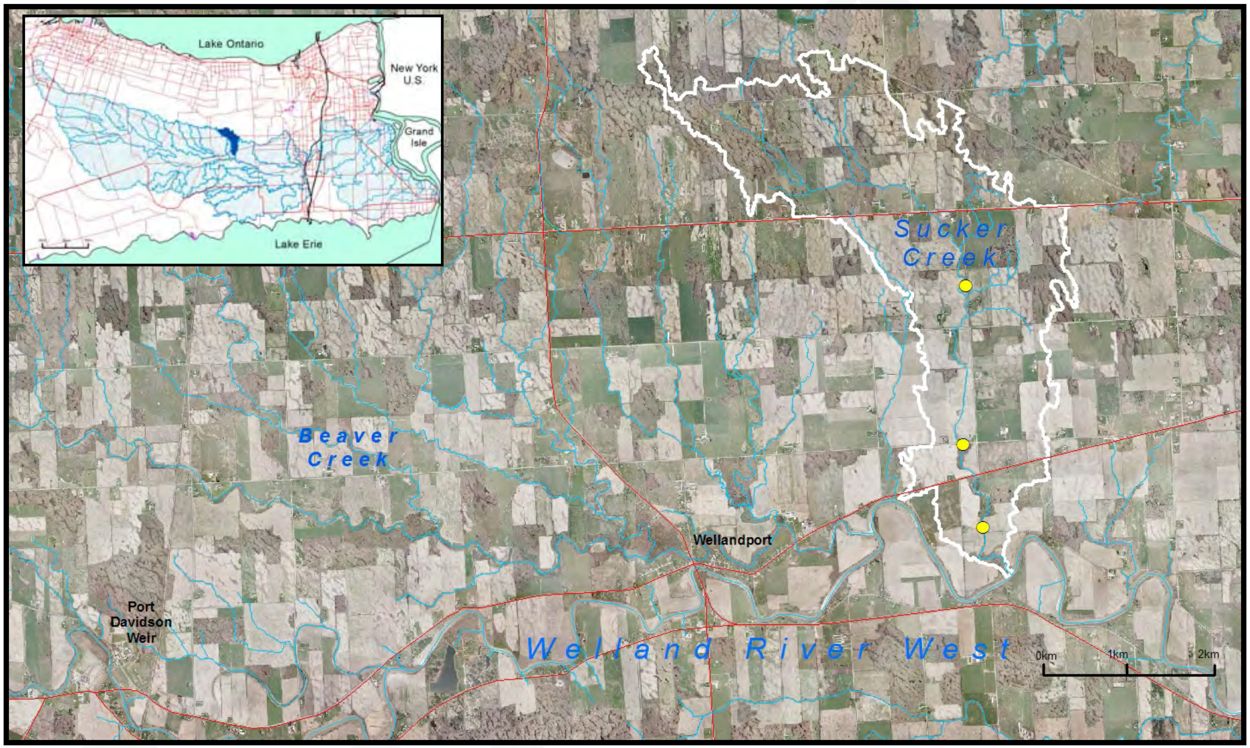


**Figure 51 Sucker Creek sampling stations**

### Sucker Creek Summary

| | |
|---|---|
| Summer Flow regime: | permanent summer habitat, plus remnant pool habitat in the headwaters<br>No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Channel composition is a mixture of riffle and runs, separated by deeper pool habitat. Soft clay substrate throughout with loose mucky fines and silt in mid reach. Moderate instream cover predominately undercut banks in lower and woody debris in middle regions. Moderate gradient tributary, 0.0677 m/s average instantaneous velocity. |
| Top Manangement Recommendations | Determine source of round goby occurance<br>Work with municipality on improving habitat in drain using natural channel design principles. |

**Table 34 Species Relative Abundance for Sucker Creek**

| Common Name | Scientific Name | 2008<br>Oct 3 stns |
|---|---|---|
| Central Mudminnow | *Umbra limi* | 0.3% |
| Golden Shiner | *Notemigonus crysoleucas* | 14.7% |
| Bluntnose Minnow | *Pimephales notatus* | 18.1% |
| Brown Bullhead | *Ameiurus nebulosus* | 6.3% |
| Green Sunfish | *Lepomis cyanellus* | 23.9% |
| Pumpkinseed | *Lepomis gibbosus* | 19.0% |
| Bluegill | *Lepomis macrochirus* | 6.3% |
| Largemouth Bass | *Micropterus salmoides* | 3.5% |
| Yellow Perch | *Perca flavescens* | 1.4% |
| Gizzard shad | *Dorosoma cepedianum* | 0.3% |
| Round Goby | *Neogobius melanostomus* | 0.9% |
| Common Carp | *Cyprinus carpio* | 5.5% |
| #SPECIES | 12 | 12 |
| #fish caught | | 348 |

Legend for Table 76

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟧 | Native sportfish |
| 🟨 | Sunfish family (other than sportfish) | 🟦 | Exotic species, including exotic sportfish |

## Black Creek (Wainfleet)

Black Creek is a small tributary to the Welland River, just downstream of Oswego Creek (Figure 52). This tributary has approximately 8.2 km of intermitted habitat within two branches. A shallow to moderate gradient in the surrounding landscape provides a mixture of small riffle and pool habitat. Due to limited residual summer habitat, 2008 sampling conducted in October was restricted to one station on a closed side road off Marshagan Road. All fish were captured in a deeper pool under the bridge. There are no historic fisheries records and no repeat sampling has been undertaken for Black Creek. Two native species captured in this tributary were a YOY northern pike and green sunfish.

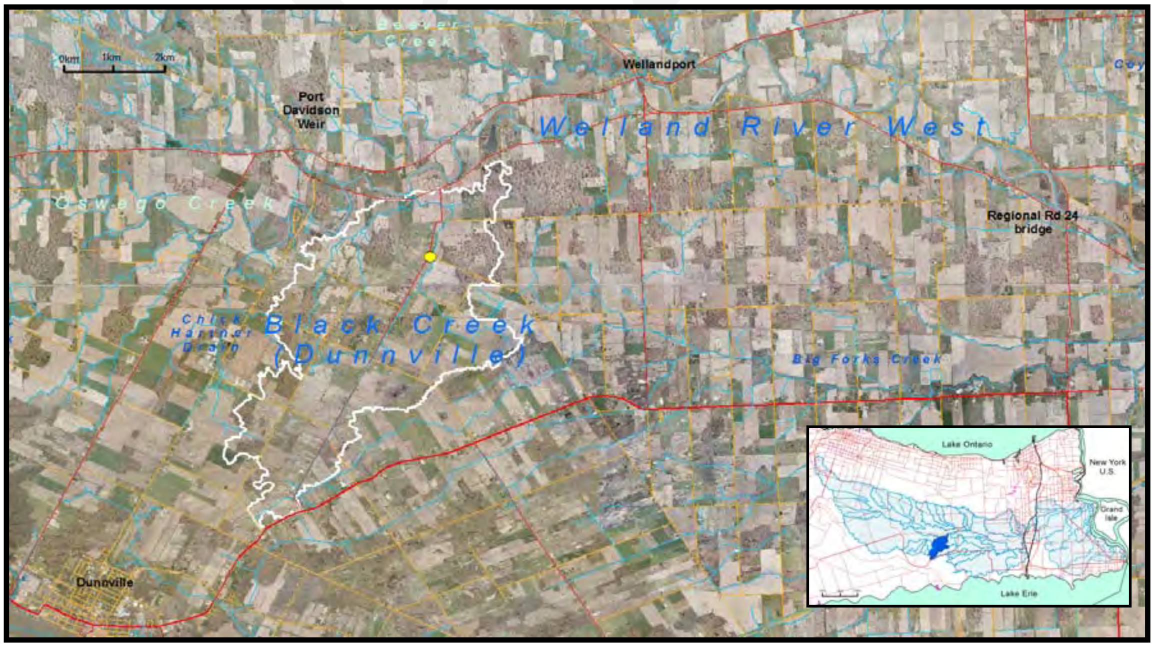


**Figure 52 Black Creek (Wainfleet) sampling stations**

**Black Creek Summary**

| | |
|---|---|
| Summer Flow regime: | 10.7 km of intermitted habitat with isolated pools, riffles and runs<br>Seasonal flow<br>No known migration barriers |
| Historic Data: | No known historic data |
| Restorative Work | No known projects. |
| Habitat | Soft clay substrate with mixture of rock and coarse rubble. |
| | Riparian vegetation includes woodlots, tall shrub and agricultural fields. Shallow gradient tributary, 0.1046m/s instantaneous velocity. |
| Management Recommendation | Enhance riparian buffer where possible |

## Oswego Creek

Oswego Creek flows into the Welland River West just downstream of the Port Davidson Weir. The Creek is estimated to have 34.6km of residual summer length extending as far upstream as the furthest west sampling point (Figure 53). The Canborough Weir retains water through the summer but even in the dry summer of 2007 there was still flow at this point in the tributary. A fish bypass channel was added to the Canborough Weir in 2003 that provides a continuous small flow path through the summer low flow period (Natural Resource Solutions, 2003). A telemetry study conducted in 2003 showed upstream and downstream movement of northern pike through the bypass channel during spring flows, however, that study also found that the bypass channel became 'dry and non-functional' during the lowest summer flows in 2003 (Biotactic, 2003). Electrofishing in July of 2003 found 14 bluntnose minnow within the bypass channel, indicating it was functioning during the dispersal period.

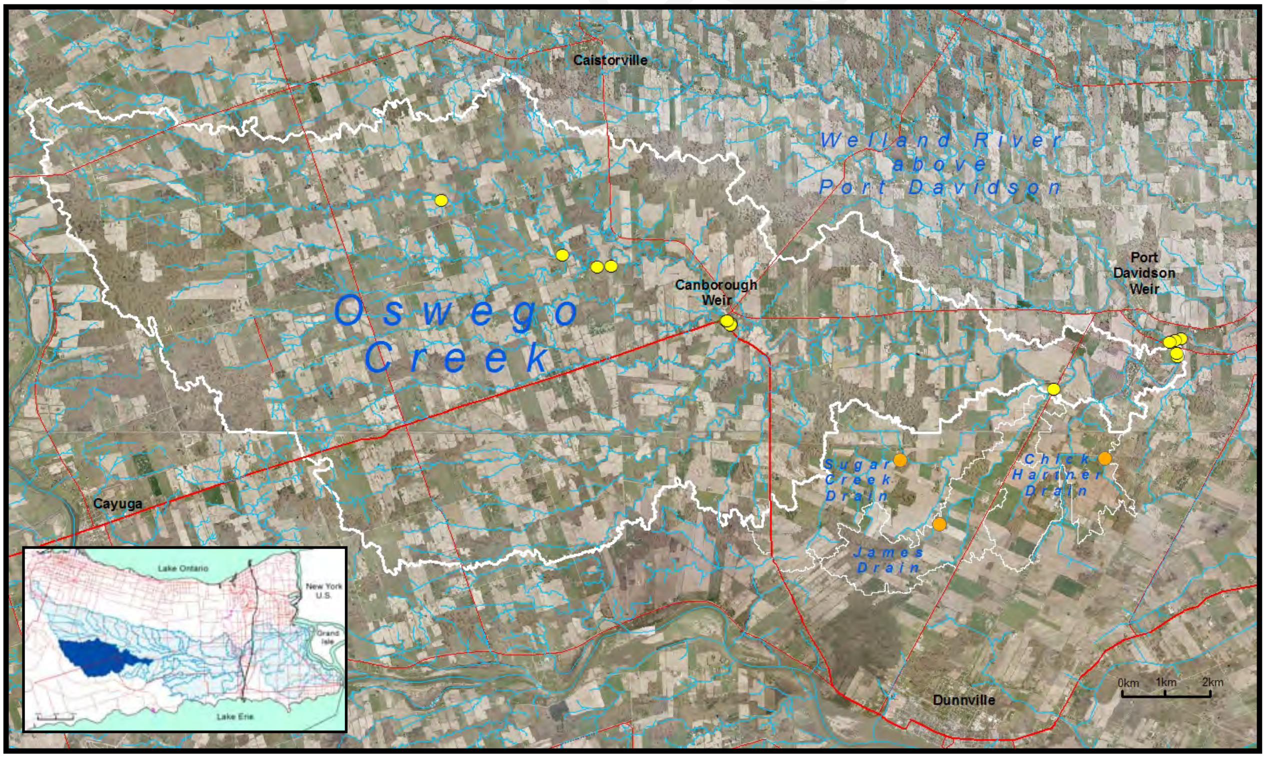


Figure 53 Oswego Creek sampling stations

Table 35 shows the relative abundances of 34 species caught in the creek including one Species-at-Risk, grass pickerel (COSEWIC – Special Concern). Sampling results are presented as repeat sampling immediately above and below the Canborough weir (2 stations 1999, 2003-2005 & 2007), comprehensive sampling of the creek (4 stations in 2004 not including the mouth), and samples within the creek mouth (spring 2004 and 2008). Sampling at the mouth found several species not collected from mid and upper reaches of the creek. These include adult shorthead redhorse, juvenile and adult catfish, juvenile and adult largemouth bass, common shiners and freshwater drum of several age classes. Total fish caught in 2004 and 2005 are high due to large abundances of sunfish.

Repeat sampling above and below the weir is separated out and shown as presence/absence indicating changes in the community since the weir retrofit (Table 36). After construction, 3 species unique to the upstream portion of the creek (central mudminnow, grass pickerel and Johnny darter) were found downstream. Four species not previously found upstream of the weir were collected from that location after the retrofit (quillback carpsucker, gizzard shad, goldfish and common carp). Of these quillback carpsucker and gizzard shad are considered “migratory”, moving upstream in times of higher flow for spawning, and their presence that far up the creek, along with emerald shiner, is attributed to improved flow in the system.

Several species were collected from below the weir only (bluegill, emerald shiner, logperch, white perch, blackside darter and bowfin). This data suggests that the weir is successful in passing some species but may not be used by all species. While both increased diversity and appearance of “migratory” species point toward a successful project, it is necessary to point out improved fish passage includes spread of exotic species (goldfish, gizzard shad and common carp).

Stocking of pike for the fish passage telemetry study at the Canborough weir in 2003 resulted in collection of 42 YOY pike in summer of 2003 at the stations immediately upstream and downstream of the weir (11.5% relative abundance that year) indicating spawning activity where the pike were released. No adults were caught in 2003 and sampling since 2003 has caught adult pike in abundances similar to pre-stocking conditions. No YOY have been collected from Oswego Creek around the weir since that time suggesting it is not normally used as spawning habitat. During the telemetry study pike were observed spawning in James Drain (an Oswego Creek tributary) and another unnamed Oswego Creek tributary above the weir. The study also identified 2 other small tributaries of Oswego Creek below the weir that were ‘probable’ pike spawning habitat (Biotactic, 2003).

The telemetry study also identified bigmouth buffalo spawning sites observed in May, 2003 at 2 locations on the main stem of Oswego Creek below the Canborough Weir, one of which is approximately 200m downstream of the confluence of James Drain and Oswego Creek. Bigmouth buffalo move out of lakes and large rivers into small tributary streams and marshes or flooded lake margins to spawn. Eggs are broadcast and adhere to vegetation (Scott & Crossman, 1998).

Also during the telemetry study, a sulphur spring was located on Oswego Creek approximately 1.25km above the Canborough Weir. During the 6 month telemetry study no pike movement was recorded near or above the spring. It was also noted that after the spawning period northern pike released in the Oswego Creek moved around twice as much as pike released in the Welland River main stem pike. The author suggested that this behaviour resembled that of displaced fish and suggested that post-spawning habitat for adult pike may be limited in Oswego Creek compared to the Welland River.

## Table 35 Species Presence and Relative Abundance Oswego Creek

| COSEWIC | Common Name | Scientific Name | 2 Repeat Stns u/s & d/s of Canboro Weir 2007 Oct | 2005 Oct | 2004 Oct | 2003 Jul | 1999 Sep | 2004 Oct 4stns | 2004 May 1stn near mouth | 2008 May 1stn Near mouth |
|---|---|---|---|---|---|---|---|---|---|---|
|  | Bowfin | *Amia calva* |  | 0.1% |  |  |  |  | 2.0% |  |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 0.5% | 0.4% | 0.7% | 1.9% | + | 0.6% |  |  |
|  | Central Mudminnow | *Umbra limi* | 1.9% | 0.4% | 0.5% | 1.1% | + | 0.9% |  |  |
|  | Quillback Carpsucker | *Carpiodes cyprinus* |  |  | <0.1% |  |  | <0.1% |  |  |
|  | White sucker | *Catostomus commersoni* | 1.2% | 0.1% |  | 0.5% | + |  |  |  |
|  | Shorthead Redhorse | *Moxostoma macrolepidotum* |  |  |  |  |  |  | 2.0% |  |
|  | Redhorse | *Moxostoma* sp |  |  |  |  |  |  | 2.0% |  |
|  | Black Bullhead | *Ameiurus melas* | 2.9% | 4.1% | 2.2% | 4.4% |  | 2.0% |  |  |
|  | Yellow Bullhead | *Ameiurus natalis* | 2.4% | 0.4% | 0.3% |  | 7.5% | 0.2% |  | 1.1% |
|  | Brown Bullhead | *Ameiurus nebulosus* | 17.0% | 17.4% | 3.0% | 11.5% | 1.3% | 3.9% | 14.3% | 8.6% |
|  | Tadpole Madtom | *Noturus gyrinus* | 0.7% | 0.5% | 0.7% | 1.4% | 0.1% | 1.3% |  |  |
|  | Channel Catfish | *Ictalurus punctatus* |  |  |  |  |  |  |  | 1.1% |
|  | Freshwater Drum | *Aplodinotus grunniens* |  |  |  |  |  |  | 26.5% | 9.7% |
|  | Johnny Darter | *Etheostoma nigrum* | 8.1% | 2.1% | 2.6% | 0.3% | + | 3.3% |  |  |
|  | Blackside Darter | *Percina maculata* |  |  | <0.1% |  |  | <0.1% |  |  |
|  | Logperch | *Percina caprodes* |  | 0.1% |  | 0.3% |  |  |  |  |
|  | Golden Shiner | *Notemigonus crysoleucas* | 0.2% | 2.7% | 4.1% | 4.4% | 0.1% | 3.4% | 2.0% | 8.6% |
|  | Emerald Shiner | *Notropis atherinoides* |  | 0.1% |  | 0.3% |  |  |  | 1.1% |
|  | Common Shiner | *Luxilus cornutus* |  |  |  |  |  |  |  | 1.1% |
|  | Bluntnose Minnow | *Pimephales notatus* | 22.2% | 3.1% | 5.9% | 5.5% | 16.1% | 4.5% |  |  |
|  | Fathead Minnow | *Pimephales promelas* |  |  | 0.2% | 0.5% |  | 0.2% |  |  |
|  | Green Sunfish | *Lepomis cyanellus* | 13.2% | 24.8% | 40.7% | 11.8% | 17.0% | 35.8% |  |  |
|  | Pumpkinseed | *Lepomis gibbosus* | 10.3% | 37.7% | 28.6% | 36.3% | 12.9% | 31.8% | 26.5% | 26.9% |
|  | Bluegill | *Lepomis macrochirus* | 0.5% |  |  | 0.5% |  | 0.5% | 4.1% | 2.2% |
|  | sunfish | *Lepomis* sp. | 8.4% |  |  |  | 0.1% |  |  |  |
|  | Northern Pike | *Esox lucius* | 0.2% |  | 0.1% | 11.5% | 0.3% | 0.1% |  | 1.1% |
|  | Largemouth Bass | *Micropterus salmoides* |  |  |  |  |  |  |  | 1.1% |
|  | White Crappie | *Pomoxis annularis* | 4.5% | 0.1% | 1.5% | 7.4% | 33.8% | 1.8% |  | 3.2% |
|  | Black Crappie | *Pomoxis nigromaculatus* | 3.6% | 4.2% | 6.2% |  | 8.9% | 5.3% | 4.1% | 3.2% |
|  | Yellow Perch | *Perca flavescens* |  |  |  |  |  |  | 2.0% | 4.3% |
|  | Walleye | *Stizostedion vitreum* |  |  |  |  |  |  | 2.0% |  |
|  | Gizzard Shad | *Dorosoma cepedianum* |  |  | 2.6% |  |  | 4.2% |  |  |
|  | White Perch | *Morone americana* |  |  |  |  | 1.0% |  | 10.2% | 2.2% |
|  | Goldfish | *Carassius auratus* | 0.5% | 0.1% | 0.1% | 0.3% | 0.1% | 0.1% |  | 4.3% |
|  | Common Carp | *Cyprinus carpio* | 1.7% | 1.5% |  |  | 0.6% | 0.1% |  | 20.4% |
|  | *#SPECIES* | 34 | 19 | 19 | 18 | 18 | 14 (18) | 21 | 12 | 17 |
|  | *#fish caught* |  | 418 | 1582 | 2133 | 364 | 683 | 2803 | 49 | 93 |

Legend for Table 35

|  |  |  |  |
|---|---|---|---|
| 🟩 | Native Minnow family | ▨ | Sucker family |
| 🟨 | Sunfish family (other than sportfish) |  |  |
| 🟧 | Native sportfish | SC | COSEWIC - Special Concern |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence at other stations above the weir |

## Table 36 Species Presence/Absence in Oswego Creek sampling near weir before and after retrofit

| COSEWIC | Common Name | Scientific Name | Presence before | | | Presence after | | |
|---|---|---|---|---|---|---|---|---|
| | | | u/s | both | d/s | u/s | both | d/s |
| | Bowfin | *Amia calva* | | | | | | + |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | + | | | | + | |
| | Central Mudminnow | *Umbra limi* | + | | | | + | |
| | Quillback Carpsucker | *Carpiodes cyprinus* | | | | + | | |
| | White sucker | *Catostomus commersoni* | | + | | | + | |
| | Black Bullhead | *Ameiurus melas* | | | | | + | |
| | Yellow Bullhead | *Ameiurus natalis* | | + | | | + | |
| | Brown Bullhead | *Ameiurus nebulosus* | | + | | | + | |
| | Tadpole Madtom | *Noturus gyrinus* | | + | | | + | |
| | Johnny Darter | *Etheostoma nigrum* | + | | | | + | |
| | Blackside Darter | *Percina maculata* | | | | | | + |
| | Logperch | *Percina caprodes* | | | | | | + |
| | Golden Shiner | *Notemigonus crysoleucas* | | + | | | + | |
| | Emerald Shiner | *Notropis atherinoides* | | | | | | + |
| | Bluntnose Minnow | *Pimephales notatus* | | + | | | + | |
| | Fathead Minnow | *Pimephales promelas* | | | | | + | |
| | Green Sunfish | *Lepomis cyanellus* | | + | | | + | |
| | Pumpkinseed | *Lepomis gibbosus* | | + | | | + | |
| | Bluegill | *Lepomis macrochirus* | | | | | | + |
| | Northern Pike | *Esox lucius* | | + | | | + | |
| | White Crappie | *Pomoxis annularis* | | + | | | + | |
| | Black Crappie | *Pomoxis nigromaculatus* | | + | | | + | |
| | Gizzard Shad | *Dorosoma cepedianum* | | | | | + | |
| | White Perch | *Morone americana* | | | + | | | + |
| | Goldfish | *Carassius auratus* | | | + | | + | |
| | Common Carp | *Cyprinus carpio* | | | + | | + | |
| | #SPECIES | 26 | 3 | 11 | 3 | 1 | 19 | 6 |

Legend

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, including exotic sportfish |
| 🟨 | Sunfish family (other than sportfish) | ⬛ | Sucker family |
| 🟧 | Native sportfish | | |

### Oswego Creek Summary

| | |
|---|---|
| Summer Flow regime: | Permanent habitat over 34.618km, 11.49ha. |
| Historic Data: | MNR 1976 survey, ROM historic records |
| Restorative Work: | Canborough Weir refit, 2003 |
| Habitat: | Low gradient wetland stream with soft silty clay substrate & minor components of cobble and boulder. Small pockets where channel is narrow with coarser material (gravel, cobble). Sparse to no instream cover |
| Fish Community Objectives: | • Maintain or improve habitat to support grass pickerel<br>• Maintain current level of connectivity to Welland River<br>• Increase resident sucker species to 2 or more<br>• Increase resident minnow species from 5 to > 8<br>• Increase abundance of resident sport fish species to >10% |
| Top 3 Manangement Recommendations: | 1. Increase marsh wetland size and quality at main river interface / estuary<br>2. Improve riparian buffer width and quality in watershed<br>3. Improve insteam habitat (woody material, submergent plants) |

## *Chickhart, James & Sugar Creek Drains*

Chickhart, James and Sugar Creek Drain are tributaries of Oswego Creek (see Oswego Creek map for location, Figure 54). Summer sampling was restricted due to lack of water. James Drain was completely dry. Discharge data from the 2003 northern pike telemetry study indicated that James Drain discharge was negligible by the end of June (Biotactic, 2003) Chichhart Drain contained water from a recent rain event, but no fish were collected or observed.

The Sugar Creek Drain site located on the east side of Melick Road, had been recently dredged, and sites upstream and downstream of this location were dry and devoid of fish. Fish collected from Sugar Creek Drain are predominantly of the sunfish family but include central mudminnow (Table 37)

**Table 37 Species Relative Abundance for Sugar Creek Drain**

| **COSEWIC** | **Common Name** | **Scientific Name** | **2008 Oct** |
|---|---|---|---|
| | Central Mudminnow | *Umbra limi* | 5.60% |
| | Green Sunfish | *Lepomis cyanellus* | 55.60% |
| | Pumpkinseed | *Lepomis gibbosus* | 38.90% |
| | #Species | *3* | 3 |
| | #fish caught | | 18 |

Legend

| | |
|---|---|
| 🟨 | Sunfish family (other than sportfish) |

## *4.8 WELLAND RIVER UPSTREAM OF PORT DAVIDSON TO BINBROOK RESERVOIR*

Above the Port Davidson Weir, the Welland River extends approximately 70km uninhibited until it reaches the Binbrook Reservoir (Lake Niapenco), where the lake outflow structure is impassable to upstream fish migration (Figure 54). Regulated discharge from the reservoir is meant to provide low flow augmentation to this reach through the low flow periods in winter and summer, however at present, this water source is not consistently released during those periods (NPCA, 2006). Two spring-fed tributaries also provide year round flow to this river reach, and there are anecdotal reports of springs in other tributaries and the river bed itself, but evidence of these water sources was not evident in the 2007 sampling, during a very dry year. The first 6.5km upstream of Port Davidson is deep enough to still require boat survey and included 4 stations surveyed by this method. From this point upstream to the reservoir, the river is wadeable and sampling was usually conducted by hand seining, and less frequently backpack electrofishing (4 of 25 sites).

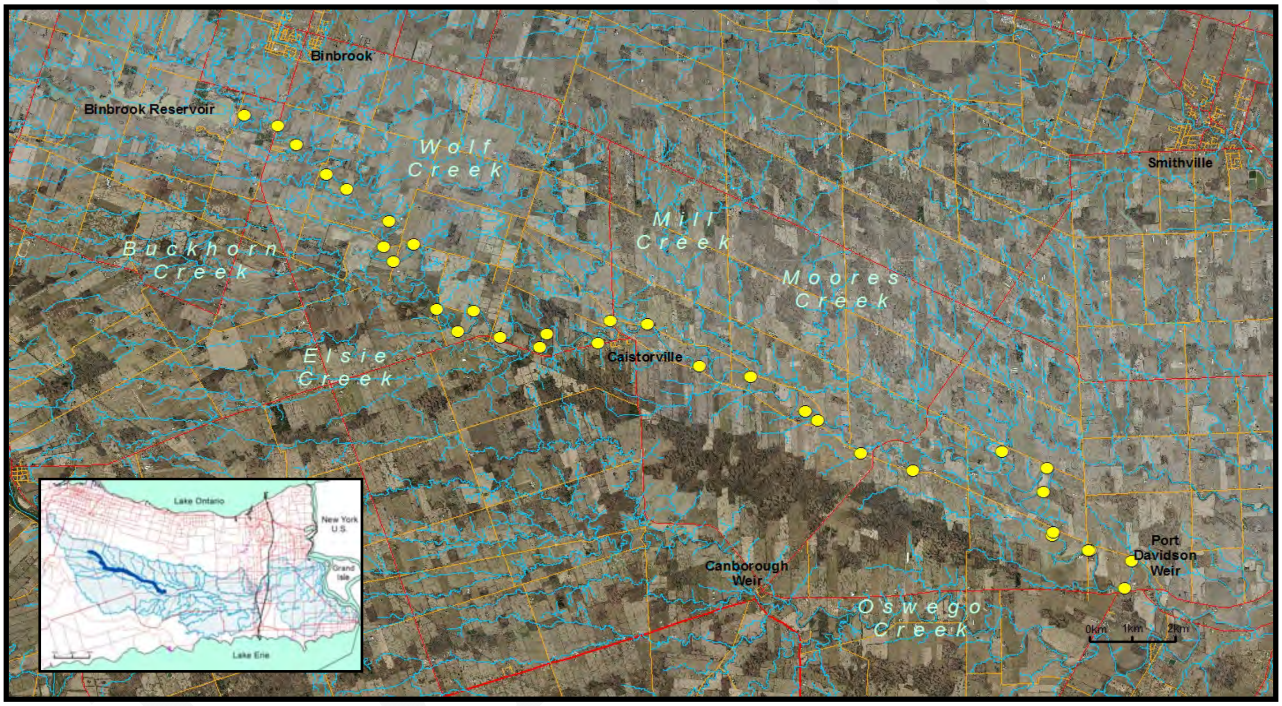


**Figure 54 Welland River Upstream of Port Davidson Sampling Stations**

Table 38 lists the 33 species collected from this ARA including one Species at Risk, grass pickerel (COSEWIC - Special Concern). Limited sampling done in 1996 collected 12 commonly occurring species, all caught again in 2007. Creek chub, fathead minnow, black bullhead, central mudminnow and grass pickerel are present in the main stem here but are generally considered tributary species suggesting a transition to tributary characteristics in the main stem towards the reservoir. Species from the Welland River West not found here include bowfin, gizzard shad and emerald shiner. Goldfish and bigmouth buffalo were also not found in the main stem here but each had an incidental occurrence of 1 individual in a tributary of this ARA. The presence of bigmouth buffalo suggests successful mitigation upstream through the Port Davidson weir. Collection of a single greater redhorse in 2008 also points to successful fish movement across the weir.

Consistent collection of walleye within the lower part of this stretch reflects some success of MNR stocking since 1997 as part of this study. Annual stocking of walleye fingerlings occurred immediately upstream and downstream of the Port Davidson weir. Sampling for walleye in the fall of 2005 collected a YOY, a juvenile and several adults (data not shown). Adult walleye collected in 2007 as part of the sampling of the whole ARA were collected from as far as 15km upstream of the stocking site. In the fall of 2008 individuals in the 4 to 6 year age class as well as 1 juvenile were sampled.

Two species, mimic shiner and blackside darter are somewhat unique to this part of the watershed. Mimic shiner makes up 9.5% of the 2007 catch in the ARA, and has been found only incidentally in recent studies in one other parts of the Upper Niagara River watershed (1 individual in the WRE in 1997). Historically, there is one ROM record for mimic shiner in Lyon’s Creek, a tributary of the Welland River East. Samples of mimic shiner from the 2007 survey were verified by ROM. Blackside darter, represents 1.6% of the 2007 catch making it the 12th most abundant species in the sample. Blackside darter has been found nowhere else in the Upper Niagara River watershed outside of this ARA, except an incidental occurrence in Oswego Creek, a tributary of the WRW (1 individual in 1 of 3 sampling years). Johnny darter and white sucker are more abundant in the Welland River above Port Davidson, (1.9% abundance and 19.3% abundance respectively) after almost near absence in the Welland River West. White sucker in the main stem include both YOY and several larger age classes. White sucker are absent from the tributaries in this ARA except for the 3 upper most tributaries which have small schools of YOY white sucker. Largemouth bass found throughout all ARAs downstream were found in only the lower ~13km of the main stem of this ARA and included YOY and adults.

Half way along the ARA substrate changes from a mix of coarse material (sand, gravel, rubble, boulder and clay) to almost 100% clay or clay and silt, with very occasional occurrences of coarser material. The fisheries community reflects this divide (highlighted in Table 16). Ten species found in the lower part of the river are not found in the upper half: shorthead redhorse, mimic shiner, yellow bullhead, walleye, largemouth bass, channel catfish, logperch, brook silverside, freshwater drum and white perch. In addition the abundance of rock bass, pumpkinseed, bluegill and yellow perch drop to less than 0.1% of the catch in the upper half of the ARA. Common shiner and creek chub are two species found in the upper half that are absent from the lower half. Overall fish communities in the two halves differ by 12 species. This kind of species partitioning was not apparent in the downstream ARAs.

2007 sampling occurred during a 50 year low for summer precipitation. Summer flow from the Binbrook reservoir and the ground water fed tributaries was hardly sufficient to maintain flow to the lower half of the river. Below Abingdon Road the river was intermittent with 100m long stretches of exposed river bed showing the dominance of coarse material (Figure 55). A small flow in these areas was still perceptible, but was at times subsurface through the coarse bed material.

In the upper half of the ARA the channel substrate is dominated by finesand the channel is wide and sluggish with average wet width in 2007 of 8m. Flow was slight to imperceptible through most of the reach. Water was generally clear, even in the upper half where sediment size was finer, but soft silt deposits were common in the upper half and when disturbed would result in a long lasting suspension of fines. Aquatic vegetation and instream cover was generally sparse to moderate, with few occasions where instream vegetation together with large and small woody debris bumped the assessment up to a dense rating. Instream vegetation was more abundant in the upper part of the ARA, but was obviously reduced in 2007 compared to years of more normal precipitation. This conclusion is based on field observations of low shelves of quite dense wetland vegetation just above the current wet edge. These shelves in normal precipitation years would have been submerged (Figure 56).

**Figure 55 Welland River Upstream Port Davidson showing dominance of coarse substrate at stations in the lower half of the ARA- summer 2007**

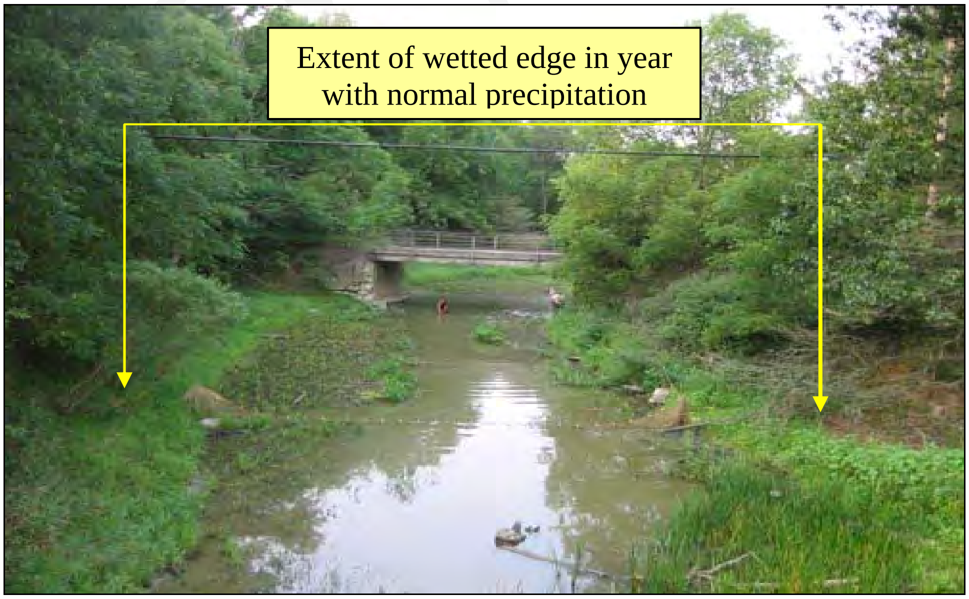


**Figure 56 Welland River above Port Davidson in upper half where substrate is dominated by finer material. Arrows show approximate normal extent of summer water level based on channel form and wetland vegetation.**

## Table 38 Species Presence and Relative Abundance Data - Welland River Above Port Davidson Species

| COWE WIC | Common Name | Scientific Name | 2008 Oct 2 stns Boat EF | 2005 Nov 2stns Boat EF | 1996 Sep 2stns Boat EF | 2007 Aug/Sep 25stns seine | 2007 11stns Upper half fine substrate | 2007 14stns Lower half coarser substrate | Tribs |
|---|---|---|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | | | 0.1% | <0.1% | 0.2% | + |
| | Central Mudminnow | *Umbra limi* | | | | 0.1% | 0.2% | 0.1% | + |
| | Bigmouth Buffalo | *Ictiobus cyprinellus* | 2.5% | 0.8% | | | | | + |
| | White sucker | *Catostomus commersoni* | | | | 1.9% | 4.1% | 0.4% | + |
| | Shorthead Redhorse | *Moxostoma macrolepidotum* | | 0.4% | | <0.1% | | <0.1% | |
| | Greater Redhorse | *Moxostoma valenciennesi* | 6.4% | | | | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 1.3% | 0.4% | | 0.6% | 0.9% | 0.3% | + |
| | Black Bullhead | *Ameiurus melas* | | | | 0.2% | 0.4% | 0.1% | + |
| | Yellow Bullhead | *Ameiurus natalis* | | 0.4% | + | 0.1% | | 0.1% | + |
| | Channel Catfish | *Ictalurus punctatus* | 2.5% | | | 0.2% | | 0.3% | |
| | Tadpole Madtom | *Noturus gyrinus* | | | + | 1.9% | 2.8% | 1.3% | + |
| | Brook Stickleback | *Culaea inconstans* | | | | | | | + |
| | Logperch | *Percin caprodes* | | | + | 0.1% | | 0.2% | |
| | Johnny Darter | *Etheostoma nigrum* | | | + | 19.3% | 29.6% | 12.2% | + |
| | Blackside Darter | *Percina maculata* | | | + | 1.6% | 1.1% | 1.9% | + |
| | Brook Silverside | *Labidesthes sicculus* | | | | 0.8% | | 1.4% | |
| | Freshwater Drum | *Aplodinotus grunniens* | 8.9% | 0.4% | | <0.1% | | 0.1% | |
| | Bluntnose Minnow | *Pimephales notatus* | | | + | 21.6% | 36.1% | 11.5% | + |
| | Fathead Minnow | *Pimephales promelas* | | | | 0.1% | 0.3% | 0.1% | + |
| | Brassy Minnow | *Hybognathus hankinsoni* | | | | | | | + |
| | Mimic Shiner | *Notropis volucellus* | | | + | 9.5% | | 16.0% | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 1.2% | 2.0% | | 1.4% | 2.7% | 0.5% | + |
| | Common Shiner | *Luxilus cornutus* | | | | 0.1% | 0.3% | | |
| | Creek Chub | *Semotilus atromaculatus* | | | + | 1.5% | 3.7% | | + |
| | Minnow species | CYPRINIDAE | | | | <0.1% | | <0.1% | |
| | Rock Bass | *Ambloplites rupestris* | | 2.4% | + | 9.4% | 0.8% | 15.4% | + |
| | Green Sunfish | *Lepomis cyanellus* | | 0.4% | + | 4.9% | 5.8% | 4.4% | + |
| | Pumpkinseed | *Lepomis gibbosus* | 19.2% | 23.4% | + | 8.9% | 3.3% | 12.8% | + |
| | Bluegill | *Lepomis macrochirus* | 20.9% | 47.2% | | 3.3% | <0.1% | 5.6% | + |
| | Sunfish | *Lepomis sp* | | 0.8% | | 8.1% | 3.7% | 11.1% | |
| | Largemouth Bass | *Micropterus salmoides* | | 1.2% | | 0.1% | | 0.2% | |
| | Northern Pike | *Esox lucius* | | | | 0.1% | 0.1% | <0.1% | + |
| | White Crappie | *Pomoxis annularis* | 2.4% | 0.8% | | 0.2% | 0.1% | 0.2% | + |
| | Black Crappie | *Pomoxis nigromaculatus* | 7.7% | 2.8% | | 2.3% | 2.9% | 1.9% | + |
| | Yellow Perch | *Perca flavescens* | 4.9% | 11.7% | | 0.5% | <0.1% | 0.9% | + |
| | Walleye | *Stizostedion vitreum* | 11.3% | 2.4% | | <0.1% | | 0.1% | |
| | Gizzard shad | *Dorosoma cepedianum* | 9.5% | | | | | | |
| | White Perch | *Morone americana* | 1.3% | 2.0% | | <0.1% | | 0.1% | |
| | Common Carp | *Cyprinus carpio* | | 0.4% | + | 0.9% | 1.3% | 0.6% | + |
| | #SPECIES | 36 | 14 | 17 | 12 | 33 | 22 | 30 | 26 |
| | #fish caught | | 81 | 248 | | 10,206 | 4,170 | 6,036 | |

Legend

| | | | |
|---|---|---|---|
| 🟩 | native minnow & darter family | SC | Special Concern |
| 🟨 | dunfish family (other than sportfish) | ⬛ | sucker family |
| 🟦 | exotic species, including exotic sportfish | 🟧 | native sportfish |

### 4.8.1 Tributaries Upstream Port Davidson Weir

A survey of the Welland River above Port Davidson was conducted in 2007, which was an extremely dry year. Most of the catchment water courses were completely dry and cracked, with only ten tributaries containing summer habitat. Of these ten tributaries only Buckhorn Creek and the Church Road tributary had obvious spring feeds with permanent summertime flow. Anecdotal reports by local residents indicate Elsie Creek is spring fed, but the 2007 field assessment found no evidence of discharge from the creek to the Welland River. The other 7 tributaries consisted of remnant pool summer habitat only and in some cases only a single pool associated with a road crossing culvert. Elsie Creek and Moores Creek (tributary to Mill Creek) were resampled in 2009 when there was considerably more precipitation. Species common to these 10 tributaries are also common to the Welland River West tributaries (Table 39).

**Table 39 Species Common to Welland River Tributaries, Upstream of Port Davidson**

| Species Common to Tributaries U/S of Port Davidson | | Common to all Welland River West tributaries | Also found in all Chippawa Channel tribs | Also found in all NR tribs |
|---|---|---|---|---|
| Central Mudminnow | *Umbra limi* | + | + | + |
| Golden Shiner | *Notemigonus crysoleucas* | + | + | + |
| Tadpole Madtom | *Noturus gyrinus* | + | + | |
| Brown Bullhead | *Ameiurus nebulosus* | + | + | + |
| Black Bullhead | *Ameiurus melas* | + | | |
| Green Sunfish | *Lepomis cyanellus* | + | + | + |
| Pumpkinseed | *Lepomis gibbosus* | + | + | + |
| Black Crappie | *Poxomis nigromaculatus* | + | | |

Buckhorn Creek had the highest relative abundance of fish and the largest amount of summer resident fish habitat, followed by Mill Creek then Elsie Creek. All of the Wolf creeks and unnamed tributaries comprise less than 25% of the summer resident fish community, reflecting the small amount of water remaining in these tributaries during summer low flow conditions. However, despite the small amount of available habitat, fish density can in the thousands within the remnant pools, depending of course on presence and abundance of predators also in the pools.

Many local residents had little expectation of the summertime fisheries value of this part of the Welland River, and particularly expected there to be no fish remaining in the tributaries during the summer. However, in the 10 tributaries with summer habitat, we sampled over 12,000 fish representing 28 species.

The 2007 sampling covered 1.6km of creek reach in the 10 tributaries. Field estimate and air photo interpretation estimated total available wet length in these tributaries in 2007 at approximately 5.5km, which represents about the same amount of available habitat as the average single tributary in other parts of the watershed. Though habitat is comparatively sparse in these tributaries, remnant pool habitat supports such tributary species as grass pickerel and northern pike. Though not as abundant as within the Upper Niagara River tributaries, these species were relatively abundant and wide spread here compared to their abundance in tributaries in the Welland River West. Grass pickerel were found in the five larger tributaries in this part of the Welland River, with abundance as high as 15 individuals within one 30mx8m reach of pool habitat. Grass pickerel were predominantly found in the tributaries with abundant aquatic vegetation and clear water, but there were also few occurrences in the main stem in areas with heavier aquatic plant growth or thick margins of soft organic soil and emergent plants.

The two groundwater fed tributaries (Buckhorn Creek and Church Road tributary) do not appear to effect species distribution in the Welland River, except that Buckhorn Creek supports the largest population of brook stickleback in the Upper Niagara River watershed. The two tributaries together with the Binbrook

Reservoir discharge provide continuous flow to this part of the river in the summer months. The water quality associated with the first 500m downstream of the springs does not support fish, but beyond that distance fish abundance appears not to be effected.

Wilson Creek was not surveyed as part of this study, but was identified as pike spawning habitat during the 2003 telemetry study of the Port Davidson and Canborough weirs. The 20 northern pike used for the telemetry study were all taken from Wilson Creek. 'Several' grass pickerel and golden shiners were captured inadvertently from Wilson Creek while netting northern pike from the first 500m of tributary length. Though not classed as a municipal drain, the upper portions of Wilson Creek traverse agricultural fields and northern pike spawning was observed in pools that are subject to dredging. Additionally, pike spawning was observed within the marshy mouth of the next downstream tributary of the Welland River near the village of Attercliffe above the Port Davidson weir (Biotactic, 2003).

Of note an Iowa darter was found in the Trinity Church Road tributary and was not found recently in any other part of the Upper Niagara River watershed. Last records of Iowa darter are from MNR surveys of the Niagara River main stem in 1964 and 1972 and from Welland River 1976 in the vicinity of the Trinity Church Road tributary.

A plot of available habitat versus estimated abundance gives highly correlated results ($r^2$=0.93). This indicates fish abundance is limited in the tributaries equally by habitat availability (Figure 57). Mill Creek has the most diverse habitat types resulting in the highest species diversity. The two spring fed tributaries, Buckhorn Creek and Church Rd Tributary show the lowest scores.

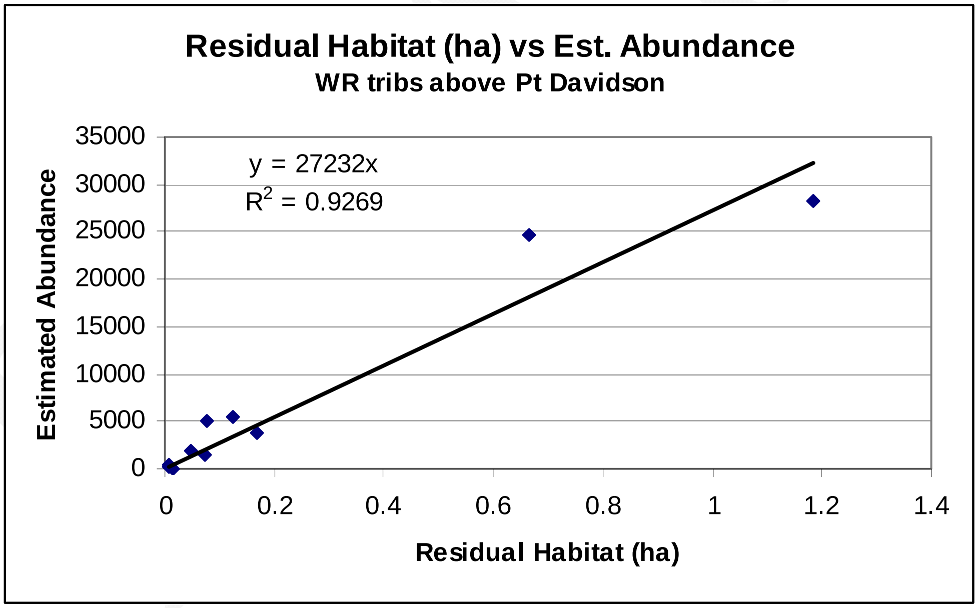


**Figure 57 Residual Habitat vs Estimated Abundance in WR tributaries above Port Davidson**

## Church Road Tributary

Church Road tributary is one of two spring fed tributaries upstream of Port Davidson. Summer habitat originates at the spring. Flow from the creek in 2007 was 1L/s, which was not ample enough to create obvious surface flow in the Welland River below the tributary confluence, but contributed to remnant pools in the Welland River. Sampling 200m downstream of the spring found no fish, though green frog and northern leopard frog were observed. Sampling approximately 400m downstream of the spring (12m upstream of the confluence with the Welland River) collected bluntnose minnow and green sunfish (Table 40). Water quality associated with the spring water may limit fish distribution in the creek. In Buckhorn Creek where more detailed study has occurred, fish were first detected in small numbers 350m downstream of the spring source. Abundance increased 500m downstream of the spring. The Church Road tributary had less than 500m summer habitat in the dry year of 2007, and surveyed habitat is presumed to still be within a detrimental influence of the spring water quality. Cattails dominate creek side vegetation closer to the spring. Figure 58 shows sampling locations in 2007.

**Table 40 Church Road Tributary Species List**

| COSEWIC | Common Name | Scientific Name | 2007 Sep 2stns |
|---|---|---|---|
| | Bluntnose Minnow | *Pimephales notatus* | 75% |
| | Green Sunfish | *Lepomis cyanellus* | 25% |
| | # SPECIES | *2* | 2 |
| | #FISH COLLECTED | | 8 |
| | Area sampled (ha) | | 0.006 |

**Legend**

| | |
|---|---|
| 🟩 | Native Minnow Family |
| 🟨 | Sunfish family (other than sportfish) |

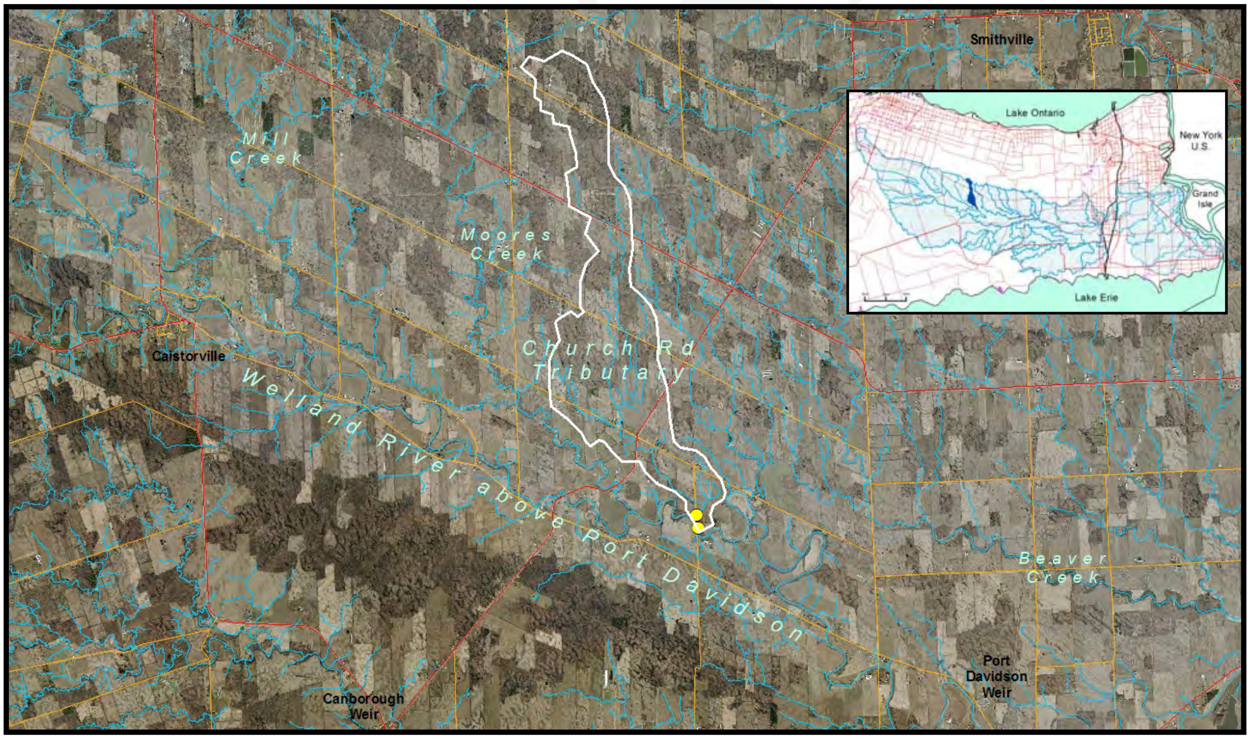


Figure 58 Church Rd tributary sampling stations

### Church Road Tributary Summary

| | |
|---|---|
| Summer Flow regime: | Sulphurous spring fed tributary with permanent flow over 200m (0.013ha). No isolated remnant pool habitat above the spring in 2007. |
| Historic Data: | No historic fisheries surveys |
| Restorative Work: | No known projects |
| Habitat: | Moderate gradient stream, 0.33m/s velocity, mix of rubble, gravel, sand in a clay substrate. |
| Fish Community Objectives: | Important source of groundwater base flow into Welland River<br>Maintain current level of connectivity to Welland River<br>Fish presence not expected to improve duirng low flow seasons |
| Top 3 Manangement Recommendations: | 1. Protect amount of water by reducing heating of water and evaporative losses by planting riparian shrubs for shade<br>2. Longterm monitoring of the amount of waterflow using data level loggers<br>3. Determine whether water quality can be enhanced through riffle construction |

## Mill Creek & Moores Creek

Mill Creek has the highest species diversity and, next to Buckhorn Creek, the most residual habitat of tributaries above Port Davidson. Presence of large pools within a deep wooded creek valley at the upstream station adds to habitat diversity (Figure 59). Three stations sampled in 2007 collected 20 species (Table 41) including Species-at-Risk, grass pickerel (COSEWIC – Special Concern). All fish recorded historically for Mill Creek were caught in 2007, except fathead minnow. Bluegill, yellow perch and mimic shiner are unique to Mill Creek and neighbouring Wolf Creek. Rock bass are noteable as they are uncommon in tributaries above Port Davidson, though present in main stem of the Welland River in this ARA.

Twelve northern pike collected from Mill Creek ranged in size from 82mm total length (YOY) to 660mm total length indicating habitat and food to support residency of several age classes. Moores Creek is a tributary of Miller Creek. In 2007, summer habitat consisted of remnant pools at road crossings. The largest pool was approximately 25m in length. Sampling was possible at 2 locations only, neither of which had enough water to seine a full 30m. The upstream location was resampled in 2009 when there was ample water for a 30m sampling. The 11 species collected in Moores Creek are all found in Miller Creek including grass pickerel. In 2007 11 northern pike were collected from the 2 small remnant pools, also representing YOY and several larger age classes. Sampling in 2009 recovered only larger pike.

### Moores Creek Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat, 0.07ha |
| Historic Data: | No known historic fisheries data |
| Restorative Work: | No known projects |
| Habitat: | Sparse rubble & gravel in a clay substrate. No instream vegetation in summer pools. |
| Fish Community Objectives: | Maintain or improve habitat to support grass pickerel<br>Maintain or improve habitat to support forage species<br>Maintain current level of connectivity to Welland River |
| Man. Recommendation: | Improve riparian buffer width and quality in watershed |

## Mill Creek Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat. Total available summer resident habitat estimated at 1100m. (0.66ha) |
| Historic Data: | 1976 MNR survey, ROM historic records. |
| Restorative Work: | No known projects |
| Habitat: | Very soft muck along some of the edges. Lots of coarse debris. Long wooded section in a deep wooded valley. |
| Fish Community Objectives: | • Maintain or improve habitat to support Grass Pickerel<br>• Maintain current level of connectivity to Welland River<br>• Increase resident minnow species diversity to > 5<br>• Increase abundance of resident intolerant fish species to >50%<br>• Increase abundance of resident sport fish species to >10% |
| Manangement Recommendation: | Improve riparian buffer width and quality in watershed |

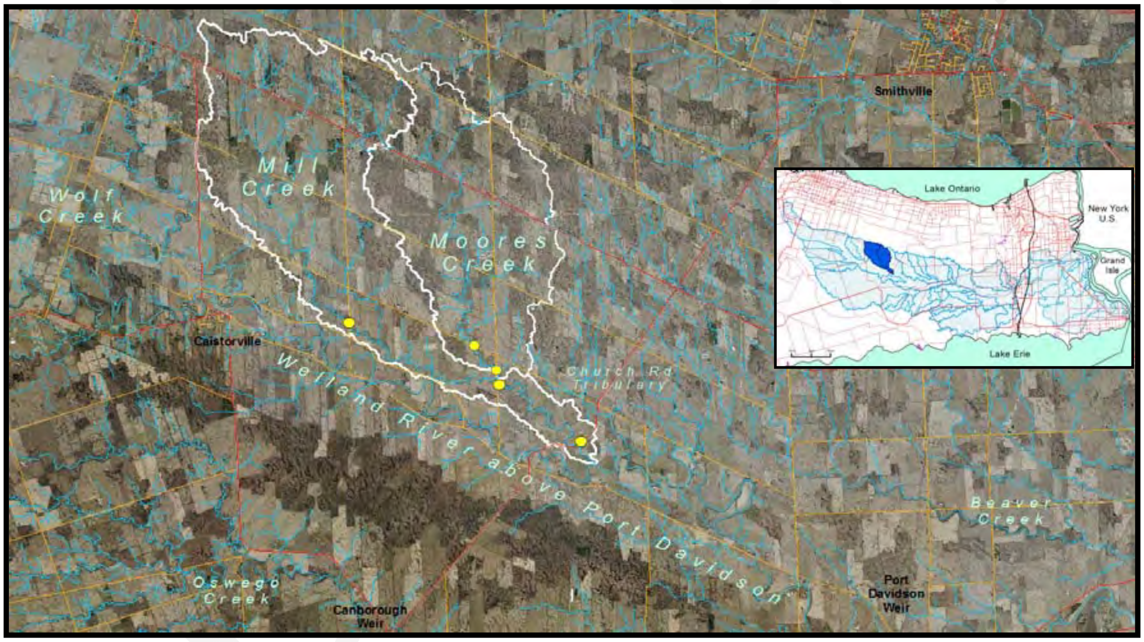


**Figure 59 Mill Creek and Moores Creek sampling stations**

## Table 41 Mill & Moore Creek Species Relative Abundance

| | | | Mill Creek | | | Moores Creek | |
|---|---|---|---|---|---|---|---|
| **COSEWIC** | **Common Name** | **Scientific Name** | **2007** Sep 3stns | **1976** MNR | **ROM** | **2009** Aug 1stn | **2007** Oct 2stns |
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 1.1% | | | 2.8% | 1.0% |
| | Central Mudminnow | *Umbra limi* | 0.4% | | + | 0.7% | 19.0% |
| | Black Bullhead | *Ameiurus melas* | 13.7% | + | + | | 6.5% |
| | Yellow Bullhead | *Ameiurus natalis* | 1.2% | | | | |
| | Brown Bullhead | *Ameiurus nebulosus* | 3.7% | + | + | 5.5% | 1.0% |
| | Tadpole Madtom | *Noturus gyrinus* | 1.9% | | | | 1.9% |
| | Johnny Darter | *Etheostoma nigrum* | 1.1% | | | | |
| | Blackside Darter | *Percina maculata* | 0.1% | | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 7.0% | + | + | 28.3% | 6.0% |
| | Mimic Shiner | *Notropis volucellus* | 0.5% | | | | |
| | Bluntnose Minnow | *Pimephales notatus* | 5.0% | + | + | | |
| | Fathead Minnow | *Pimephales promelas* | | | + | | |
| | Minnow species | | | + | | | |
| | Rock Bass | *Ambloplites rupestris* | 3.9% | | | | |
| | Green Sunfish | *Lepomis cyanellus* | 9.5% | | | 6.2% | 53.0% |
| | Pumpkinseed | *Lepomis gibbosus* | 13.4% | + | + | 4.8% | 7.2% |
| | Bluegill | *Lepomis macrochirus* | 1.0% | | | | |
| | YOY Sunfish | *Lepomis* sp. | 30.7% | | | 40.0% | |
| | Sunfish family | | | + | | | |
| | Northern Pike | *Esox lucius* | 0.6% | + | + | 5.5% | 2.7% |
| | White Crappie | *Pomoxis annularis* | <0.1% | | | 6.2% | 0.2% |
| | Black Crappie | *Pomoxis nigromaculatus* | 4.2% | + | + | | 1.4% |
| | Yellow Perch | *Perca flavescens* | 0.2% | + | + | | |
| | Common Carp | *Cyprinus carpio* | 0.6% | | | | |
| | #SPECIES | 21 | 20 | 10 | 10 | 9 | 11 |
| | #fish caught | | 2010 | | | 145 | 415 |
| | Area sampled (ha) | | 0.043 | | | 0.014 | 0.015 |

Legend for Table 41

| | | COSEWIC Status | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | + | Denotes historic presence only |

## Wolf Creek

Summer habitat is all remnant pools in Wolf Creek. There is at least one section of the creek with a nicely intact floodplain, having low topography with dense wetland plants within woodlands. Though not suitable for sampling in 2007 because of too little water, this area is a good example of a non-impacted section of Wolf Creek. Sampling was carried out at 3 locations, 2 of which were pools at road crossings (Figure 60). The most downstream site was part of a ~300m long stretch of pool with abundant duckweed and numerous grass pickerel. Sampling included 1 station within the only available pool habitat on Little Wolf Creek, a tributary of Wolf Creek.

Table 42 gives the relative abundance of the 21 species collected from Wolf Creek and Little Wolf Creek, including 1 Species-at-Risk, grass pickerel (COSEWIC – Special Concern) and 1 exotic, common carp. ROM historic records show mimic shiner, which was recaptured in 2007. All species caught in the 1976 survey were recaptured in the recent survey. Bigmouth buffalo is unique to this tributary, but has been collected from the Welland River just upstream of Port Davidson, ~15km downstream of Wolf Creek. Northern pike collected from Little Wolf Creek included 1 juvenile and 3 adults. Results show very large numbers (>1000 each) of YOY sunfish and bluntnose minnow collected at the sampling location on Wolf Creek with only a single grass pickerel, compared to only a handful of these forage species where grass pickerel density was higher.

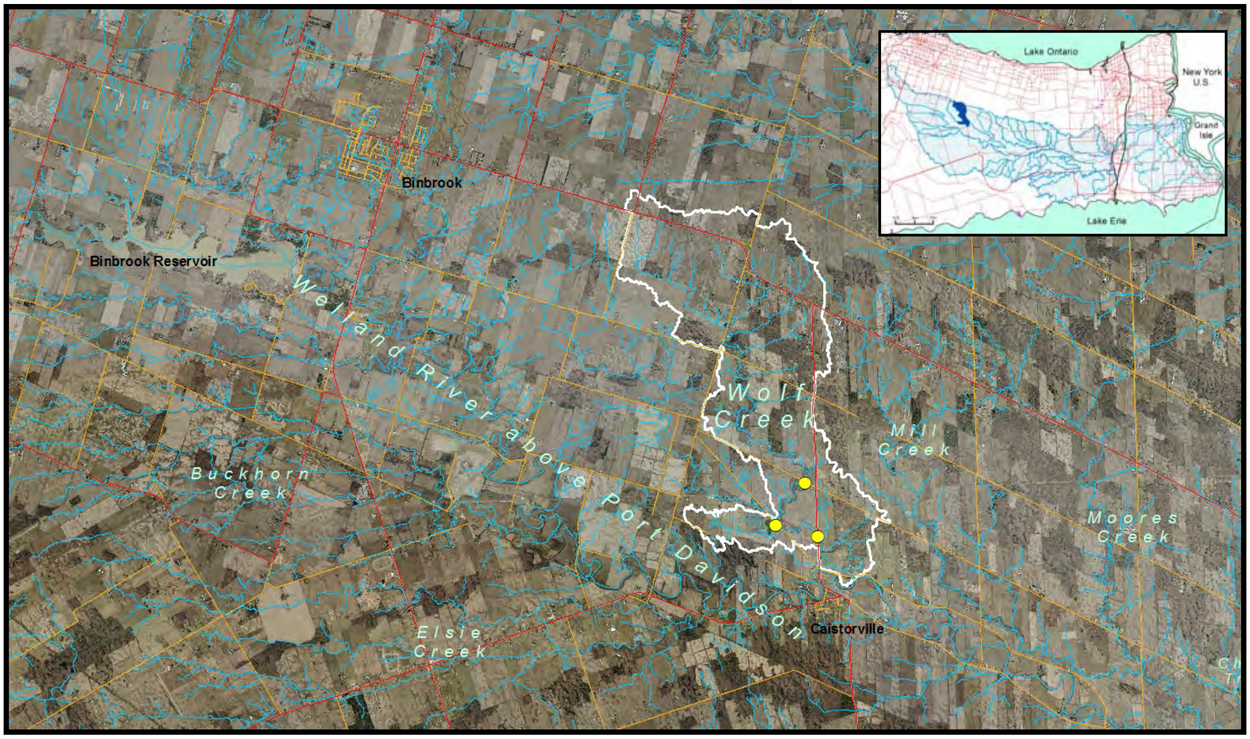


Figure 60 Wolf Creek Sampling Locations

## Wolf Creek Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat 0.073ha |
| Historic Data: | MNR 1976 survey, ROM Historic Record |
| Restorative Work: | No known projects |
| Habitat: | Sparse rubble and gravel in clay in upstream pools, soft loose fines with sparse algae duckweed and woody debris in the downstream area |
| Fish Community Objectives: | Maintain or improve habitat to support grass pickerel |
| | Maintain or improve habitat to support forage species |
| | Maintain current level of connectivity to Welland River |
| Manangement Recommendation: | Improve riparian buffer width and quality in upper watershed |

**Table 42 Wolf Creek Species Relative Abundance**

| COSEWIC | Common Name | Scientific Name | **2007** Sep 2stns | MNR 1976 | ROM | L. Wolf 2007 Sep 1stn |
|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | 0.2% | | | 0.4% |
| | Central Mudminnow | *Umbra limi* | 0.1% | | | 0.3% |
| | Bigmouth Buffalo | *Ictiobus cyprinellus* | | | | 0.1% |
| | Black Bullhead | *Ameiurus melas* | 6.5% | + | | 42.5% |
| | Yellow Bullhead | *Ameiurus natalis* | 0.1% | + | | 0.5% |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.4% | + | | 0.9% |
| | Tadpole Madtom | *Noturus gyrinus* | 3.7% | | | 11.9% |
| | Johnny Darter | *Etheostoma nigrum* | 0.5% | + | | 0.6% |
| | Blackside Darter | *Percina maculata* | 0.1% | | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 6.4% | + | | 2.5% |
| | Mimic Shiner | *Notropis volucellus* | 0.1% | | + | |
| | Bluntnose Minnow | *Pimephales notatus* | 31.0% | + | | 1.5% |
| | Fathead Minnow | *Pimephales promelas* | 0.1% | | | |
| | Green Sunfish | *Lepomis cyanellus* | 3.7% | | | 2.5% |
| | Pumpkinseed | *Lepomis gibbosus* | 11.5% | | | 10.8% |
| | Bluegill | *Lepomis macrochirus* | 0.2% | | | |
| | YOY Sunfish | *Lepomis* sp. | 31.0% | | | 20.6% |
| | Northern Pike | *Esox lucius* | | | | 0.4% |
| | White Crappie | *Pomoxis annularis* | 2.2% | + | | 2.0% |
| | Black Crappie | *Pomoxis nigromaculatus* | 1.8% | | | 1.4% |
| | Yellow Perch | *Perca flavescens* | 0.1% | | | |
| | Common Carp | *Cyprinus carpio* | 0.4% | | | 0.2% |
| | #SPECIES | 21 | 19 | 7 | 1 | 16 |
| | #fish caught | 4263 | 3336 | | | 927 |
| | Area sampled (ha) | 0.07 | 0.046 | | | 0.024 |

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | 🟦 | Exotic species, including exotic sportfish |
| 🟨 | Sunfish family (other than sportfish) | + | Denotes presence |
| 🟧 | Native sportfish | SC | COSEWIC Special Concern |

## Elsie Creek

Sampling in 2007 was limited to two areas with large pools in wooded areas 130m and 2.4km upstream of the mouth. Above the sample areas Elsie Creek was a dry channel predominantly running through farm fields. In 2007 some dredging of the channel in this vicinity occurred, similar to that noted for West Wolf Creek. Local residents indicated there are springs in the wooded areas, as the pools never dry out. Sampling in 2009 repeated the station near the creek mouth and sampled 3 new stations at road crossing pools in the upper reaches of the creek which had been dry in 2007 (Figure 61).

Table 43 shows the relative abundance of the 11 species collected including one Species-at-Risk, grass pickerel (COSEWIC – Special Concern). All species collected historically were also collected in recent surveys. Grass pickerel were relatively abundant compared to other tributaries in the area as indicated by collection of 14 individuals from one 30m station and 5 individuals from the second station in 2007. The creek stations sampled in 2007 had a moderate amount of submergent aquatic plant growth and woody debris, with emergent and floating vegetation components at the lower station, and an abundance of string algae at the upper pool. Sampling in the upper reaches in 2009 added 4 new species: rock bass and white crappie collected from the repeat station near the creek mouth, and fathead minnow and creek chub in remnant pools in the upper reaches. Pike included 2 YOY and 2 adults of different age classes in 2007 and 3 adults of similar size in 2009.

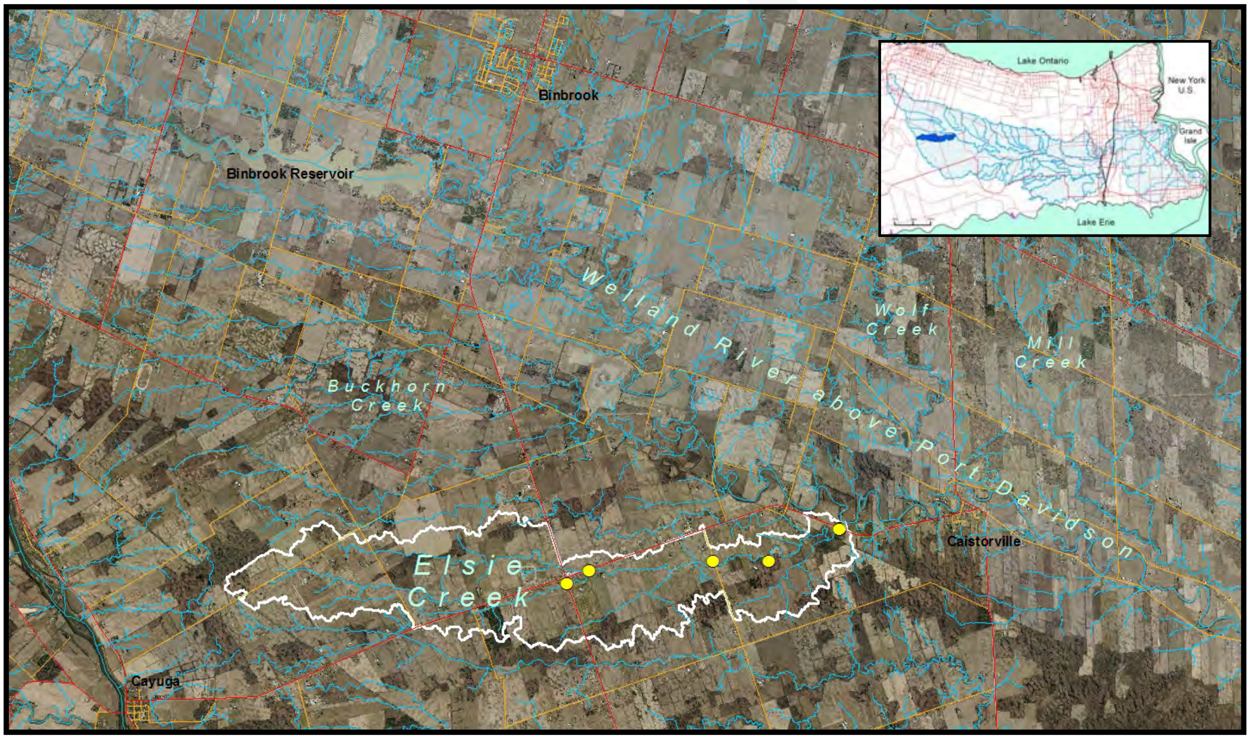


Figure 61 Elsie Creek Sampling Locations

## Elsie Creek Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat. Anecdotal springs, but no evidence in 2007 of flow from creek to Welland River, 0.17ha. |
| Historic Data: | 1976 MNR records, historic ROM record |
| Restorative Work: | No known projects |
| Habitat: | Sparse rubble and rock in clay and loose silt substrate. Moderate emergent, submergent and floating vegetation with moderate woody debris. |
| Fish Community Objectives: | Maintain or improve habitat to support grass pickerel<br>Maintain or improve habitat to support forage species |
| | Maintain current level of connectivity to Welland River |
| Manangement Recommendation: | Improve riparian buffer width and quality in watershed |

**Table 43 Elsie Creek Species Presence and Relative Abundance**

| **COSEWIC** | **Common Name** | **Scientific Name** | **2009** 4 stns | **2007** 2 stns | **MNR 1976** | ROM |
|---|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | 2.5% | | |
| | Central Mudminnow | *Umbra limi* | 4.2% | 21.8% | | |
| | Black Bullhead | *Ameiurus melas* | | 6.9% | + | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 7.1% | 2.2% | + | |
| | Bullhead Sp. | *Ameiurus sp.* | 2.4% | | | |
| | Tadpole Madtom | *Noturus gyrinus* | | 16.8% | | |
| | Johnny Darter | *Etheostoma nigrum* | | 0.8% | | |
| | Blackside Darter | *Percina maculata* | | 0.1% | | |
| | Golden Shiner | *Notemigonus crysoleucas* | 0.1% | 18.4% | | |
| | Mimic Shiner | *Notropis volucellus* | | 0.1% | | |
| | Bluntnose Minnow | *Pimephales notatus* | 0.1% | 0.1% | | |
| | Fathead Minnow | Pimephales promelas | 13.8% | | | |
| | Creek Chub | Semotilus atromaculatus | 9.9% | | | |
| | Minnow family | CYPRINIDAE | | | + | |
| | Rock Bass | *Ambloplites rupestris* | 0.1% | | | |
| | Green Sunfish | *Lepomis cyanellus* | 55.8% | 7.6% | | |
| | Pumpkinseed | *Lepomis gibbosus* | 3.9% | 19.6% | + | |
| | YOY Sunfish | *Lepomis* sp. | | 0.7% | | |
| | Northern Pike | *Esox lucius* | 0.3% | 0.5% | | |
| | White Crappie | *Pomoxis annularis* | 0.1% | | | |
| | Black Crappie | *Pomoxis nigromaculatus* | 0.3% | 0.8% | | |
| | #SPECIES | 17 | 13 | 14 | | |
| | #fish caught | | 1109 | 766 | | |
| | Area sampled (ha) | | 0.036 | 0.034 | | |

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | COSEWIC Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ⬜ | Sucker family | | |

## Buckhorn Creek

Summer flow in Buckhorn Creek in 2007 appeared to be derived wholly from a vigorous spring with permanent flow approximately 2km upstream of the mouth. Only remnant pool habitat remained above the spring source. The spring discharge is adjacent to the creek channel within the floodplain. Flow is routed to the creek through a 4m long rock lined channel. Fish surveys were conducted both upstream and downstream of the spring (Blott, 2007) (Figure 62). Water quality of the spring appears to inhibit fish survival. No fish were collected at a station 150m downstream of the spring. Fish were first detected 350m downstream of the spring in small numbers (22fish/30m section of seined creek length). At 500m downstream of the spring, seining a 30m section of creek collected over 1000fish, mostly brook stickleback, but also included central mudminnow, Johnny darter, carp and pumpkinseed. The spring has been the subject of previous studies (Bundt, 2005) that determined spring water quality is affecting fish survival for approximately 500m downstream during summer low flow conditions. No studies have been undertaken to determine the extent of the effect during periods outside of low flow conditions. Buckhorn creek supports the largest population of brook stickleback in the Welland River watershed with over 1000 individuals collected from one station.

The only top predator in Buckhorn Creek was northern pike, found in a remnant pool upstream of the permanent flow from the spring. Northern pike included YOY and several larger sizes up to 667mm total length. Grass pickerel were noticeably absent from Buckhorn Creek which may be the result of water quality associated with the spring water as the organic soil and aquatic plant components appear otherwise suitable and grass pickerel are within the Welland River near Buckhorn Creek.

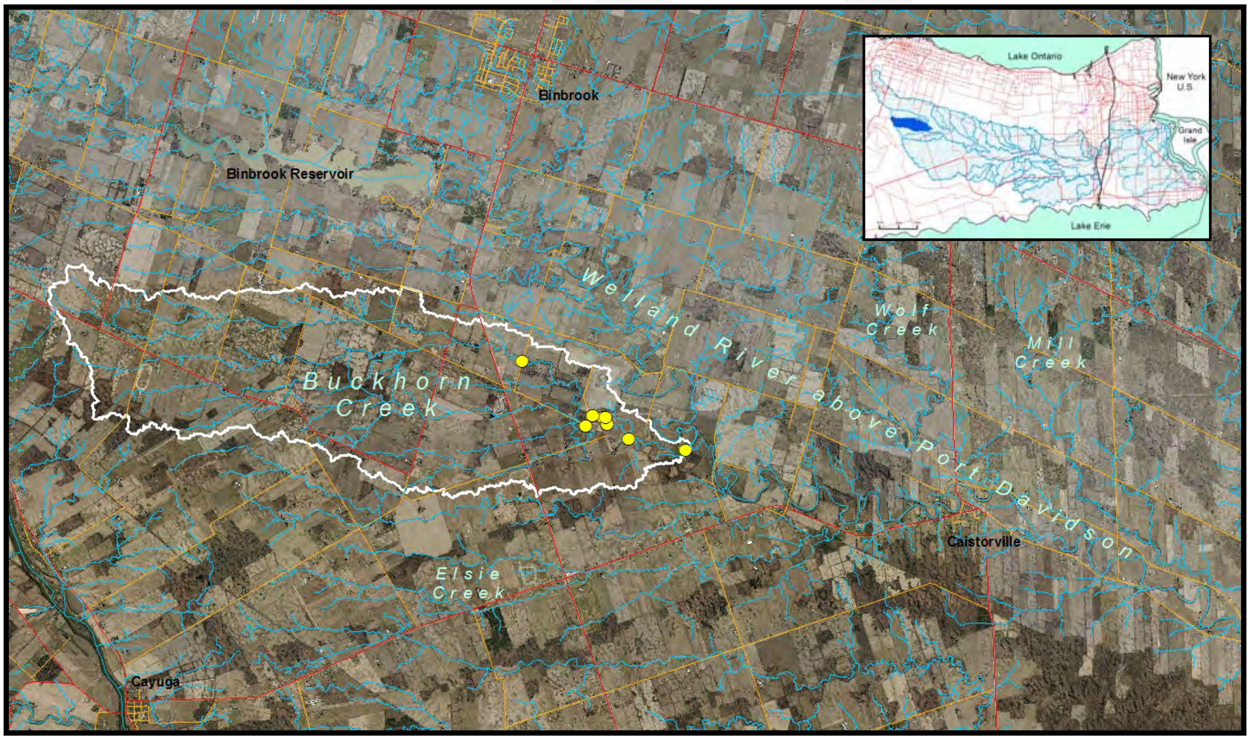


**Figure 62 Buckhorn Creek Sampling Locations**

## Buckhorn Creek Summary

| | |
|---|---|
| Summer Flow regime: | Spring fed tributary, permanent flow, remnant pool habitat above spring, 1.18ha |
| Historic Data: | Species presence/absence (Bundt, 2005) |
| Restorative Work: | No known projects, but MNR has proposed a linear side channel to surface route spring water and mitigate water quality issues prior to its entry into the creek (Blott, 2007). |
| Habitat: | Abundant instream vegetation over more than 600m associated with the groundwater spring water. Moderate woody debris in wooded sections of the creek. Downstream reaches have sparse instream vegetation. |
| Fish Community Objectives: | • Important source groundwater base flow into Welland River<br>• Maintain current level of connectivity to Welland River<br>• Resident Fish community not expected to improve duirng low flow seasons |
| Manangement Recommendations: | 1. Protect amount of water by reducing heating of water and evaporative losses by planting riparian shrubs for shade<br>2. Longterm monitoring of the amount of waterflow using data level loggers<br>3. Determine if water quality can be enhanced through riffle construction (Blott, 2007) |

**Table 44 Species Relative Abundance Buckhorn 2007**

| Common Name | Scientific Name | 2007 Jul – Sep 8stns | 2005 (Bundt) |
|---|---|---|---|
| Central Mudminnow | *Umbra limi* | 4.9% | + |
| Black Bullhead | *Ameiurus melas* | 4.6% | |
| Brown Bullhead | *Ameiurus nebulosus* | 0.6% | + |
| Tadpole Madtom | *Noturus gyrinus* | 0.6% | |
| Johnny Darter | *Etheostoma nigrum* | 1.9% | + |
| Brook Stickleback | *Culaea inconstans* | 63.4% | + |
| Golden Shiner | *Notemigonus crysoleucas* | 6.8% | |
| Bluntnose Minnow | *Pimephales notatus* | 1.5% | + |
| Brassy Minnow | *Hybognathus hankinsoni* | | + |
| Fathead Minnow | *Pimephales promelas* | 0.3% | |
| Green Sunfish | *Lepomis cyanellus* | 5.9% | + |
| Pumpkinseed | *Lepomis gibbosus* | 8.5% | + |
| Bluegill | *Lepomis macrochirus* | | + |
| YOY Sunfish | *Lepomis* sp. | 0.1% | |
| Northern Pike | *Esox lucius* | 0.4% | |
| White Crappie | *Pomoxis annularis* | < 0.1% | |
| Goldfish | *Carassius auratus* | <0.1% | |
| Common Carp | *Cyprinus carpio* | 0.3% | + |
| #SPECIES | 17 | 17 | 10 |
| #fish caught | | 2720 | |
| Area sampled (ha) | | 0.112 | |

| | | | |
|---|---|---|---|
| 🟩 | native minnow family | + | denotes presence |
| 🟨 | sunfish family (other than sportfish) | ⬜ | sucker family |
| 🟧 | native sportfish | 🟦 | exotic species, including exotic sportfish |

## West Wolf Creek

West Wolf Creek is intermittent with remnant pool summer habitat. Most of the creek length runs through farm fields within narrow, grassed or sparsely treed buffers, or less often with no buffer. Pools were almost exclusively associated with road crossing culverts, but within the uncommon forested reaches of the creek numerous several-meter-long, shallow pools exist, too small to sample. Sampling was possible at 3 pools under road culverts (pool depths up to 0.5m) (Figure 63). Table 45 gives relative abundance of 14 species collected, including YOY white sucker and 1 exotic, common carp. Northern pike do not include any YOY.

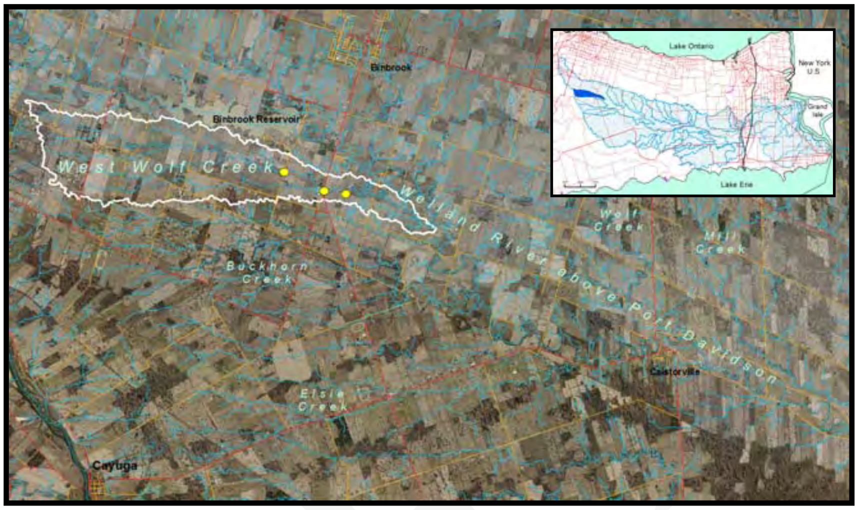


Figure 63 West Wolf Creek Sampling Locations

### West Wolf Creek Summary

| | |
|---|---|
| Summer Flow regime: | Remnant pool habitat only, 0.13ha |
| Historic Data: | No historic data |
| Restorative Work: | No known projects |
| Habitat: | Moderate component of boulder, rubble and gravel in loose silt or hard clay substrate. Sparse instream vegetation. |
| Fish Community Objective: | Maintain current level of connectivity to Welland River |
| Manangement Recommendation: | Improve riparian buffer width and quality in watershed |

Table 45 Species Relative Abundance West Wolf Creek 2007

| Common Name | Scientific Name | 2007 Jul/Aug 3stns |
|---|---|---|
| Central Mudminnow | *Umbra limi* | 2.6% |
| White sucker | *Catostomus commersoni* | 0.1% |
| Black Bullhead | *Ameiurus melas* | 21.3% |
| Brown Bullhead | *Ameiurus nebulosus* | 4.9% |
| Tadpole Madtom | *Noturus gyrinus* | 1.7% |
| Johnny Darter | *Etheostoma nigrum* | 0.4% |
| Golden Shiner | *Notemigonus crysoleucas* | 2.5% |
| Bluntnose Minnow | *Pimephales notatus* | 0.5% |
| Green Sunfish | *Lepomis cyanellus* | 45.3% |
| Pumpkinseed | *Lepomis gibbosus* | 15.1% |
| YOY Sunfish | *Lepomis* sp. | <0.1% |
| Northern Pike | *Esox lucius* | 0.3% |
| White Crappie | *Pomoxis annularis* | 1.4% |
| Black Crappie | *Pomoxis nigromaculatus* | 0.4% |
| Common Carp | *Cyprinus carpio* | 3.5% |
| #SPECIES | 14 | 14 |
| #Fish collected | | 1555 |
| Area sampled (ha) | | 0.023 |

| Legend | |
|---|---|
| ▨ | Sucker family |
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |

## Kirk Road Tributary

This intermittent tributary drains south from the town of Brinbrook. In 2007, a dry year, just one 16.5m long road culvert pool was available to sample (Figure 64). However, the upsteam and downstream channel (dry at the time) was well vegetated with riparian species associated with weter conditions, suggesting that in years with more precipitation the creek likely provides more residual summer habitat.

Two dead minnows were noted floating in the pool prior to sampling. Dissolved oxygen was recorded at noon to be 1.13mg/L. Table 46 lists 7 species collected and includes YOY white sucker. White sucker were found in the three most upstream tributaries in this part of the Welland River.

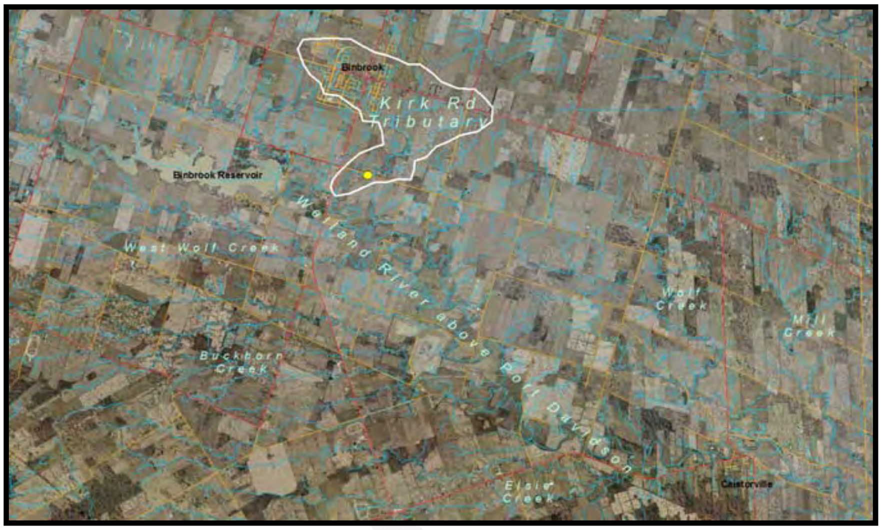


**Figure 64 Kirk Road Tributary Sampling Locations**

***Kirk Road Tributary Summary***

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat. |
| Historic Data: | No historic data |
| Restorative Work: | No known projects |
| Habitat: | Moderate amount of rubble and gravel in a clay substrate. Ample instream vegetation |
| Fish Community Objective: | Maintain current level of connectivity to Welland River |
| Man. Recommendation: | Improve riparian buffer width and quality in watershed |

**Table 46 Species Relative Abundance Kirk Road Tributary**

| COS EWIC | Common Name | Scientific Name | 2007 Aug 1stn |
|---|---|---|---|
| | White sucker | *Catostomus commersoni* | 8.1% |
| | Johnny Darter | *Etheostoma nigrum* | 22.0% |
| | Bluntnose Minnow | *Pimephales notatus* | 39.6% |
| | Fathead Minnow | *Pimephales promelas* | 7.7% |
| | Creek Chub | *Semotilus atromaculatus* | 22.0% |
| | Green Sunfish | *Lepomis cyanellus* | 0.2% |
| | Pumpkinseed | *Lepomis gibbosus* | 0.4% |
| | #Species | 7 | 7 |
| | #fish collected | | 505 |
| | Area sampled (ha) | | .004 |

| | |
|---|---|
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| ▨ | Sucker family |

## Trinity Church Road Tributary

This tributary is intermittent with a small remnant pool under Trinity Church Road on the north side of the Binbrook Reservoir (Figure 65). The system discharges into the Welland River below the reservoir. Similar to Kirk Road tributary, this creek has portions of dense riparian cover downstream of the sampling area and in wetter years would provide more residual summer habitat. Upstream the creek runs through a few backyards and creek side vegetation was mowed. The sampling pool was very shallow with soft silty muck substrate with rock and urban debris. In 2007, a dry year, 3 fish were dead in the pool prior to sampling. Table 47 lists the relative abundance of species caught from the tributary and includes white sucker (YOY) and Iowa Darter (verified by ROM). Iowa Darter is recorded from the Welland River from 1976 OMNR survey in the vicinity of this tributary.

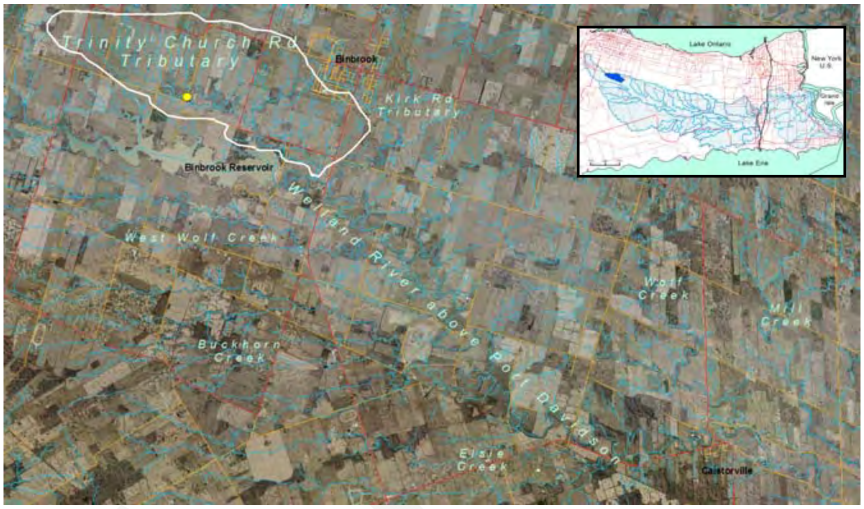


Figure 65 Trinity Church Road Tributary Sampling Locations

**Table 47 Species Relative Abundance Trinity Church Road Tributary**

| Common Name | Scientific Name | 2007 Aug 1stn |
|---|---|---|
| Central Mudminnow | *Umbra limi* | 2.4% |
| White sucker | *Catostomus commersoni* | 2.4% |
| Iowa Darter | *Etheostoma exile* | 0.5% |
| Bluntnose Minnow | *Pimephales notatus* | 12.4% |
| Fathead Minnow | *Pimephales promelas* | 25.8% |
| Creek Chub | *Semotilus atromaculatus* | 32.5% |
| Green Sunfish | *Lepomis cyanellus* | 23.9% |
| #SPECIES | 7 | 7 |
| #fish caught | | 209 |
| Area sampled (ha) | | .001 |

🟩 Native Minnow family
🟨 Sunfish family (other than sportfish)
▨ Sucker family

**Trinity Church Road Tributary Summary**

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat. |
| Historic Data: | No historic data for the tributary, but ROM historic record for Iowa Darter in the Welland River in this vicinity. |
| Restorative Work: | No known projects |
| Habitat: | Rubble in loose silt over clay. No instream vegetation at sampling location, but downstream channel in wetter years would have emergent vegetation. |
| Fish Community Objective: | Maintain current level of connectivity to Welland River |
| Man. Recommendation: | Improve riparian buffer width and quality in watershed |

## 4.9 BINBROOK RESERVOIR

Major fish kills in the Welland River in the early 1960's reciprocated several environmental studies and eventually an engineering study to remedy water related problems (Dillon, 1965). The Dillon report investigated the causes and effects of man-made water level fluctuations, design flood levels and hydrologic and hydraulic studies and outlined several projects to remedy water related issues, including low water levels (winter, summer), fluctuation, aesthetics/pollution and flooding. As a result of this study, Port Davidson Weir and Canborough Weir were constructed to maintain upstream water levels, and Binbrook Reservoir was constructed to augment base flow to the Welland River for most of the year. The report specifies water flow of 16 c.f.s for 200 day period (0.453 $m^3/s$) (Dillon, 1965).

Binbrook Reservoir is 175 ha area located in the headwaters (Figure 66). The operations included large draw downs of water levels and the storage of spring runoff. In the 1980's reservoir management diversified to include fisheries management, walleye were stocked and wetlands were identified along its margin. In the 1990's local residents were concerned about poor habitat quality and a perceived abundance of common carp. Trap netting began which showed an abundance of white crappie and a lack of walleye in the reservoir (NPCA, 1996 unpublished data). Fish studies began and water level draw downs were reduced. Habitat enhancement projects were initiated to improve forage fish habitat and possibly walleye spawning. Adult walleye were stocked by MNR in 1998 from Bay of Quinte to test the success of the habitat projects. The presence of juvenile walleye in the fish community would provide evidence that a walleye population would be self sustaining. To date no juvenile walleye have been found in the reservoir.

**Figure 66 Binbrook Reservoir 2003**

Water retention management activity sees the reservoir drawn down in the winter which has two effects on forage fish. The exposed lake bottom edge becomes denuded of vegetation that can't withstand the freezing, reducing the physical cover within this draw down zone available to minnows and other forage fish. Secondly, winter draw down concentrates forage fish and piscivores together into a central core that enhances predation reducing the forage food base. The Binbrook Reservoir Management Plan now includes a broader mandate including enhancing and maintaining recreational opportunities in the reservoir, for boating, aesthetics, fishing and wildlife viewing.

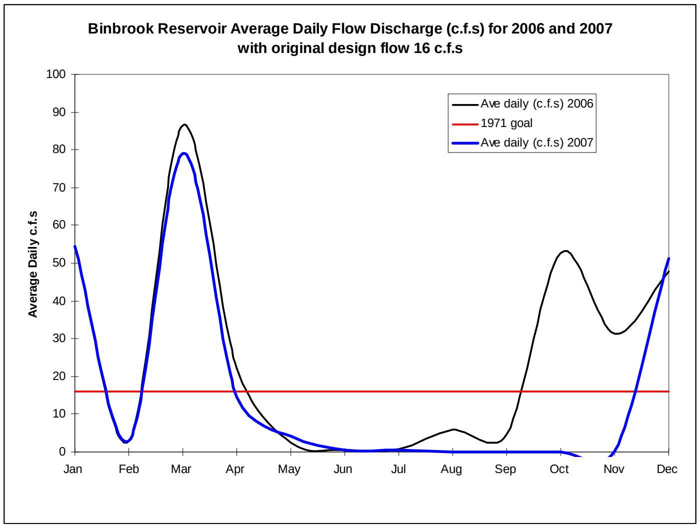


**Figure 67 Binbrook Reservoir discharge flows for 2006, 2007 and original design base flow (16 c.f.s) (NPCA data records)**

Although an extensive review of summer and winter discharge flows has not been completed, water management functions have changed to reflect these added values and the original purpose of low flow augmentation (winter and summer) has diminished (NPCA, 2006). As a result of this management change, water levels in the reservoir are no longer drastically reduced and discharges to the Welland River during low flow periods are reduced well below 16 c.f.s. In 2007 from late June to late October, no water was discharged from the reservoir (Figure 67).

The reservoir is predominantly clay or soft, silty bottom with few areas of rubble and sand. In 1997 floating, emergent and submergent vegetation was sparse. In water cover ranged from none to moderate consisting of rubble, woody debris, and aquatic vegetation. Water colour was turbid brown. Since 1997, the water level is also drawn down in summer to expose the mudflats during the growing season to promote more edge growth of emergent vegetation. Field notes in 2003 indicate that the emergent marsh vegetation along the shore line has increased somewhat from 1997 observations. The largest area of emergent wetland occurs upstream of the DU weir (Figure 68).

**Figure 68 Binbrook Reservoir Hyslops Bay Wetland Creation Project**

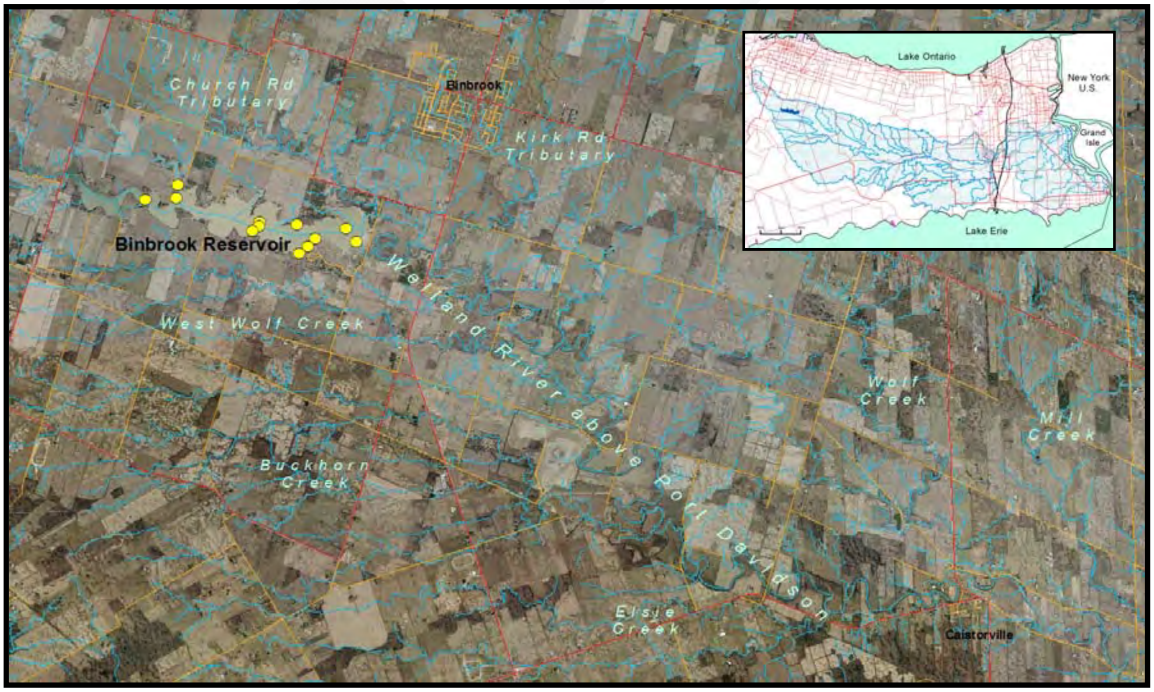


**Figure 69 Binbrook Reservoir Sampling Stations**

Fish community sampling locations in the reservoir includes repeat stations over two years 2003 (5 stations), and 1997 (Yagi, 1998). Stations appearing out from shore are sampling the shoreline of an island (Figure 69). There are twenty common species known to occur in this reservoir, no Species at Risk and one exotic Common carp (Table 48). The majority of species found are from the sunfish family (7 species) including four sportfish, largemouth bass, smallmouth bass and white and black crappie. Some hybridization is evident in the Lepomis genus. Other sport fish include northern pike and walleye (stocked). Five species of minnow (excluding carp) are also evident including two new species in 2003 (emerald shiner and common shiner) resulting from the minnow transfers in the late 1990's.

Fish sampling in 1997 represents the fish community before habitat and water management changes. Sampling in 2003 represents the fish community approximately five years after these initiatives. NPCA also conducted trap netting; seining and minnow trap study in 2002 to assess the fish community. This sampling technique was also conducted by local residents in the mid 1990's. These survey techniques were effective for 13 of the 20 known reservoir species pool however only 1 of 5 minnow species (excluding carp). Electrofishing was 85% efficient at capturing resident fish species (day or night). Boat electrofishing missed large specimens of walleye, channel catfish and brown bullhead but captured all smaller species, (cyprinids, l sunfish and other sportfish). Since boat electrofishing successfully captures all sizes of walleye in the Welland River and Grand River (MacDougall, 2006), we have assumed the larger walleye were in deeper waters during the time of our electrofishing survey and not affected by that gear. Furthermore, since no small walleye were captured in either the trap netting or electrofishing survey; we assumed that walleye do not successfully reproduce in this reservoir. Other sportfish populations, especially largemouth bass are self sustaining; this conclusion is supported by continual observations of adults, juveniles and YOY (1997 and 2003).

Adult largemouth bass were also found at the first sampling station upstream of the reservoir in the Welland River Headwaters where the influence of the reservoir backwater is still apparent. Historic stocking of the reservoir includes both bait (suckers and minnows) and sport fish (largemouth bass and walleye). Evidence of this stocking was seen in the 2003 sampling with occurrence of 3 new forage species since 1997; white sucker, emerald shiner and common shiner. Fish can move from the reservoir upstream over the DU weir into the Welland River headwaters during spring flows, but no access is available from the Welland River upstream into the reservoir.

Black and white crappie remain the most abundant fish in the reservoir in 2003, similar to past studies by NPCA (2002) and the Glanbrook Conservation Committee (1990's unpublished data). Depending on their size, these species can be either a level 1 or level 2 consumer (plankton and zooplankton). Since crappies are the most abundant fish, they also represent a significant proportion of the reservoir's forage base. Walleye stocking for a put-and-take fishery is scheduled to begin in 2008 (NPCA, pers com). Walleye are voracious fish eaters and will become cannibalistic during forage shortages. Fisheries management should focus on enhancing habitat for forage fish to maintain trophic structure. Without a diverse fish community structure nutrient flux will escalate resulting in more frequent algal blooms and poorer water quality. Recent sport fish contaminant monitoring by MOE has restricted fish consumption due to mercury and Perfluorooctane Sulfonate (PFOS), a synthetic (man-made) chemical substance contamination (MOE 2011; NPCA website, March 30, 2012).

It is unlikely that a quality self sustaining fishery can be maintained in the reservoir. An alternative management direction for the reservoir is to revert back to the original intent of the reservoir with its primary function of providing flow to the Welland River in the low flow seasons. Given this management strategy, the reservoir below the DU weir would become a floodplain pool/wetland/wet meadow feature. Additionally the outlet structure could be redesigned with a more gradual coarse material grade down to the Welland River channel to greatly improve the ecological connection to the Welland River. These ideas are presented in the recommendations of this report.

**Table 48 Species Presence and Relative Abundance Data- Binbrook Reservoir**

| COSEWIC | Common Name | Scientific Name | MNR (2003) | MNR (1997) | NPCA (2002) | 1992 GCCC Trap netting |
|---|---|---|---|---|---|---|
| | White sucker | *Catostomus commersoni* | 1.01% | | + | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 9.6% | 8.2% | | |
| | Emerald Shiner | *Notropis atherinoides* | 0.5% | | | |
| | Common Shiner | *Luxilus cornutus* | 3.5% | | | |
| | Spottail Shiner | *Notropis hudsonius* | 2.5% | 2.0% | + | |
| | Bluntnose Minnow | *Pimephales notatus* | | 7.5% | | |
| | Yellow Bullhead | *Ameiurus natalis* | 2.0% | 8.2% | | |
| | Brown Bullhead | *Ameiurus nebulosus* | | | + | |
| | Channel Catfish | *Ictalurus punctatus* | | | + | + |
| | Rock Bass | *Ambloplites rupestris* | | | | + |
| | Green Sunfish | *Lepomis cyanellus* | 2.0% | 2.0% | + | |
| | Pumpkinseed | *Lepomis gibbosus* | 8.1% | 17.8% | + | |
| | Bluegill | *Lepomis macrochirus* | 2.0% | | + | |
| | Hybrid sunfish | *Lepomis X* | | 0.7% | | |
| | Largemouth Bass | *Micropterus salmoides* | 9.1% | 8.9% | + | + |
| | Smallmouth Bass | *Micropterus dolomieu* | | 0.7% | | + |
| | White Crappie | *Pomoxis annularis* | 14.6% | 8.2% | + | |
| | Black Crappie | *Pomoxis nigromaculatus* | 27.8% | 8.2% | + | |
| | Pomoxis Species | *Poxomis* sp. | | | | + |
| | Yellow Perch | *Perca flavescens* | 8.1% | 3.4% | + | + |
| | Northern Pike | *Esox lucius* | | 1.4% | + | + |
| | Walleye | *Stizostedion vitreum* | | | + | + |
| | Common Carp | *Cyprinus carpio* | 8.1% | 15.7% | + | + |

Legend for Table 48

| | |
|---|---|
| + | Denotes presence |
| 🟩 | Native Minnow family |
| 🟨 | Sunfish family (other than sportfish) |
| 🟧 | Native sportfish |
| 🟦 | Exotic species, including exotic sportfish |
| ▨ | Sucker Species |

## Binbrook Reservoir Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat amount varries with precipitation for 21 km. Permanent habitat, contiguous with reservoir up to HWY 6 (11 km) (2007) |
| Historic Data: | 1996 data, no ROM data |
| Restorative Work: | No known projects |
| Habitat: | Predominantly fine substrate pool habitat with little submerged/emergent vegetation. Small component of coarse substrate narrow riffle type habitat & more instream veg. |
| Top Man Recommendations: | Manage as a seasonal wetland with small permanent channel<br>Improve seasonal connectivity to Welland River fish community through outflow channel and DU weir<br>Protect amount of permanent water by reducing heating of water and evaporative losses by allowing to draw down in growing season<br>Longterm monitoring of the amount of waterflow using data level loggers |

## 4.10 WELLAND RIVER HEADWATERS

The Welland River Headwaters comprises the main stem of the Welland River above the Binbrook Reservoir. Sampling in 2007 extended from the reservoir to approximately 21 km upstream, covering 5 stations. During that season continuous habitat was estimated to extend approximately 11km upstream to just west of Highway 6, beyond which one isolated pool was available under the White Church Road crossing. Three stations were resampled during September 2008, during a wet summer period. Figure 70 shows the 2007 sampling locations (yellow) and 2 stations from 1996 (orange) in a year when available habitat extended further upstream to Butler Road.

Table 49 lists 19 species found in the headwaters showing a community more closely resembling the river below the reservoir than the community in the reservoir. Central mudminnow, bluntnose minnow, grass pickerel and johnny darter are present in both the headwaters and the Welland River below the reservoir, but absent from the reservoir. The station nearest the reservoir is within the influence of the reservoir backwater. Substrate was soft loose silt and average wetted width of 16m was much greater than the other stations. Riffle habitat was rare through headwaters reach, encountered just once. Most abundant habitat type was pool.

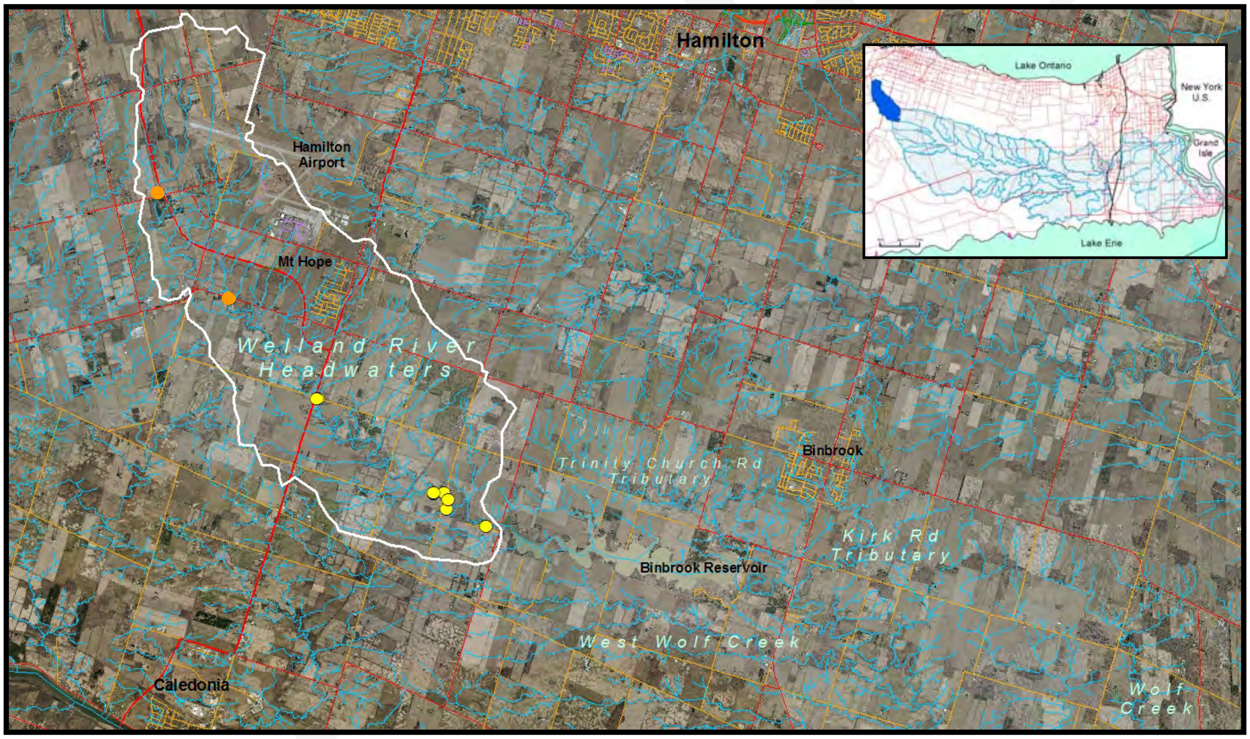


**Figure 70 Welland River Headwaters Sampling Locations. The two upstream sites were dry during the 2007 season, but sampled in a wetter year.**

## Welland River Headwater Summary

| | |
|---|---|
| Summer Flow regime: | Intermittent creek, remnant pool summer habitat amount varries with precipitation for 21 km. Permanent habitat, contiguous with reservoir up to HWY 6 (11 km) (2007) |
| Historic Data: | 1996 data, no ROM data |
| Restorative Work: | No known projects |
| Habitat: | Predominantly fine substrate pool habitat with little submerged/emergent vegetation. Small component of coarse substrate narrow riffle type habitat & more instream veg. |
| Fish Community Objectives: | Improve seasonal connectivity to Welland River fish community through reservoir and DU weir<br>Maintain or improve habitat to support Grass Pickerel<br>Maintain or improve habitat to support forage species<br>In permanent habitat areas, increase abundance of resident intolerant fish species<br>In permanent habitat areas, increase abundance of resident sport fish species |
| Top Man Recommendations: | Improve riparian buffer width and quality in watershed<br>Protect amount of permanent water by reducing heating of water and evaporative losses by planting riparian shrubs for shade<br>Longterm monitoring of the amount of waterflow using data level loggers |

**Table 49 Welland River Headwaters Presence and Relative Abundance**

| COSEWIC | Common Name | Scientific Name | 2008 Sep 3stns | 2007 Jul 5stns | 1996 |
|---|---|---|---|---|---|
| SC | Grass Pickerel | *Esox americanus vermiculatus* | | 0.2% | |
| | Central Mudminnow | *Umbra limi* | | | + |
| | White Sucker | *Catostomus commersoni* | | 1.1% | |
| | Black Bullhead | *Ameiurus melas* | 1.2% | 4.0% | + |
| | Yellow Bullhead | *Ameiurus natalis* | | | + |
| | Brown Bullhead | *Ameiurus nebulosus* | 0.3% | 3.7% | |
| | Tadpole Madtom | *Noturus gyrinus* | 1.4% | 4.0% | |
| | Johnny Darter | *Etheostoma nigrum* | 11.7% | 3.3% | + |
| | Golden Shiner | *Notemigonus crysoleucas* | 28.3% | 10.5% | |
| | Bluntnose Minnow | *Pimephales notatus* | 32.0% | 4.4% | + |
| | Green Sunfish | *Lepomis cyanellus* | 9.4% | 26.5% | + |
| | Pumpkinseed | *Lepomis gibbosus* | 4.4% | 32.3% | + |
| | YOY Sunfish | *Lepomis* sp. | 4.9% | 1.3% | |
| | Largemouth Bass | *Micropterus salmoides* | 1.0% | 0.5% | + |
| | Northern Pike | *Esox lucius* | 1.2% | 0.9% | |
| | White Crappie | *Pomoxis annularis* | 1.0% | 2.7% | + |
| | Black Crappie | *Pomoxis nigromaculatus* | 1.7% | 2.7% | |
| | Yellow Perch | *Perca flavescens* | 1.0% | 0.2% | |
| | Common Carp | *Cyprinus carpio* | 0.2% | 1.7% | + |
| | #SPECIES | 18 | 14 | 16 | 10 |
| | #fish caught | | 572 | 820 | |
| | Area sampled (ha) | | 0.067 | 0.117 | |

| | | | |
|---|---|---|---|
| 🟩 | Native Minnow family | | |
| 🟨 | Sunfish family (other than sportfish) | SC | Special Concern |
| 🟧 | Native sportfish | | |
| 🟦 | Exotic species, including exotic sportfish | + | Denotes presence |
| ▨ | Sucker family | + | Denotes historic presence only |

## *4.11 SUMMARY OF THE AQUATIC RESOURCE AREAS*

One management goal of the Niagara River watershed is to create a system that maximizes conversion of nutrients into long lived cylces within the food chain. This conversion relies on the production of a large forage fish base of small bodied, soft rayed fishes to support desirable long-lived piscivores such as muskellunge, pike, walleye, salmonines etc. In the Welland River, the bulk of this forage fish population should be compromised of copious schools of YOY suckers and redhorses, and large schools of shiners and other small fishes moving in and out from the Niagara River. This kind of population structure is evident in the Niagara River and within its direct tributaries (Frenchmans Creek, Miller Creek etc), and is evident in the Chippawa Channel and its tributaries (Lyon’s Creek, Grassy Brook etc) and evident within the Welland River East. In comparison, within the Welland River West the forage fish base is comparatively minute, and composed predominantly of sunfishes. The large schools of migrational species are missing. Migrational barriers to these fishes at the canal syphons works against maximizing this step in the food chain process within the Welland River West and above.

The second fish management goal for the Niagara River watershed is to maximize use of available habitat. Fish distribution patterns of many species indicate either numbers well below expectation or absence altogether in parts of the watershed. Migration challenges are clearly truncating the movement of anadromous species, and effectively limiting their spawning use to less than half of the Niagara River watershed (the smaller direct tributaries of the Niagara River and the Welland River watershed below the Old Welland Canal Syphons). But water quality and habitat quality continue to be a hindrance to both diversity and abundance of fish in the Welland River West in particular. Sucker species (rehorses and white sucker), which are widespread in the watersheds of the Lake Erie basin, are absent or incidental (1 or 2 individuals) in the Welland River West. Walleye also remains incidental in most parts of the Welland River West despite 15 years of stocking. In other tributary river systems such as the Grand River (tributary to Lake Erie, Ontario) and Tonawanda Creek (Niagara River tributary, New York) species such as redhorses and walleye show distribution patterns of lower abundance through more sluggish backwater areas with poorer water quality, and higher abundance in areas of better flow and cleaner water, where there is more suitable habitat, however, they are generally not absent from any one area (Wilkinson, 1995 and MacDougall and Ryan, 2012).

### 4.11.1 Welland River West Habitat Quality

Abundance of fish within ARAs speaks to quality and quantity of habitat present during the particular survey. Although sampling techniques have varied over years, abundance in terms of catch per unit effort (CPUE) within each assessment year can help explain habitat differences between sample sites. Absolute values cannot be drawn between sampling years when methods are different, but the overall trend in abundance can help explain changes over time. In 1964, fish surveys in the Welland River West have the highest CPUE compared to other sections of the Welland River. This result was more due to poorer water quality elsewhere rather than particularly good water quality in the Welland River West (Johnson, 1964) as indicated by the higher abundance in nearby Lyons Creek (control site).

This study was part of the basis for which it was determined that base flow augmentation (the Binbrook Reservoir) was required in order to alleviate poor water quality conditions throughout the Welland River. In 1964 the poorest water quality in the Welland River occurred at and below the City of Welland due to direct industrial and sewage discharges to the river. This trend was evident in reduced fish abundance in the river downstream of these outfalls through its length to the Power Canal (Figure 72).

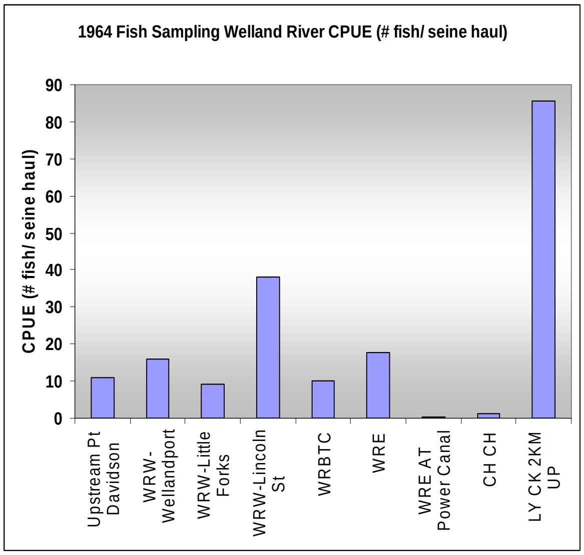


**Figure 72 CPUE by Welland River ARA in 1964**

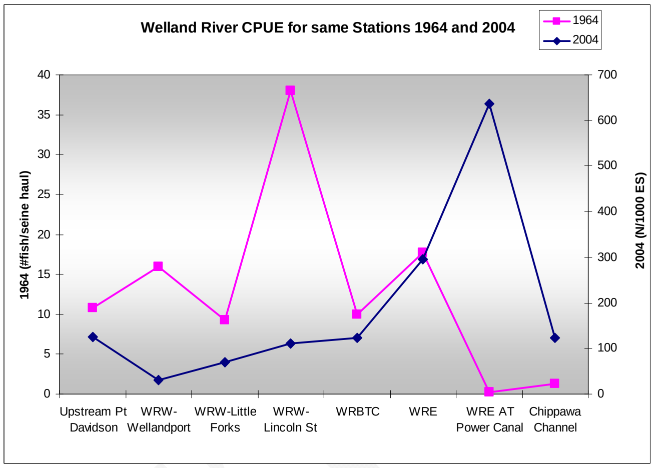


**Figure 71 CPUE in Welland River 1964 vs 2004**

It has been suggested that the 1960's era represents the worst water quality in recorded history of the Welland River, and that the present day conditions are rebounding toward recovery from the fish kills of the 1960's (A. Yagi, pers. comm.). A comparison of the 1964 fish survey results with the 2004 survey shows a shift in the relative location of the greatest CPUE (Figure 71). Improved discharge treatment has cleaned up the river at and below the City of Welland. What now becomes evident is that the highest relative abundance in 2004 is situated at the confluence of the Welland River East, Chippawa Channel and Queenston-Lewiston Power Canal which flows into the Lower Niagara River through the hydro generating stations. The Welland River West represents the lowest mean CPUE.The mean CPUE plotted with 95% confidence limits (Figure 73) shows the Welland River West in 2004 not only has low CPUE, but that CPUE between stations within the ARA varies little (very tight confidence limits), suggesting little diversity in habitat conditions through its 30km length and also little to no seasonal or annual fish community contribution from the downstream Niagara River system.

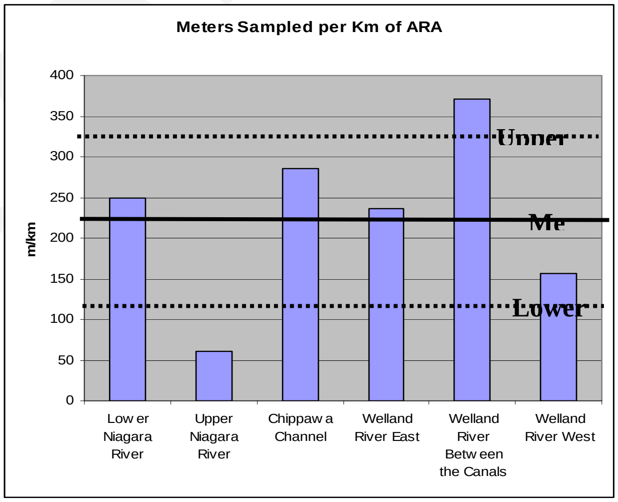


**Figure 73 Meters sampled per kilometer of ARA**

Sampling rate (m sampled per kilometre) in this part of the river was slightly below average but CPUE is not directly related to this factor, as ARAs with higher sampling rates did not result in higher mean CPUE or smaller confidence limits. The highest catch, variance and sampling rate occurred in the Chippawa Channel which is most likely a reflection of fish entrainment from high velocities close to the Niagara River and the high catch associated with proximity to the confluence/ junction with the Welland River East and Power Canal (Figure 74). When considering the amount of shoreline sampled and total available habitat (N/m) the Upper Niagara River had the highest relative abundance followed by Welland River East, Chippawa Channel and WRW (not shown). Much of the habitat homogeneity of the WRW is attributed to the effects of the water control fluctuation (sec 3.4.1) that eliminates wetland edges and enlarges the active channel. Instream habitat works are proposed in this report to address these habitat limitations to boost habitat diversity and diminish the active channel in the WRW.

The 1997 and 2004 electrofishing surveys were conducted during summer low flow and low rainfall conditions. In contrast the 2005 surveys occurred during the summer season, when flows were higher because of the continuous rainfall (Figure 4). In 2005, Welland River West had a significantly higher mean CPUE (168 +- 60) N/1000 ES then in 2004 (60+- 20) N/1000ES and 1997 (67+20) N/1000 ES for the same 6 repeat stations (Figure 75). This result suggests the importance of permanent flow to higher fish abundance in the Welland River West during the summer season.

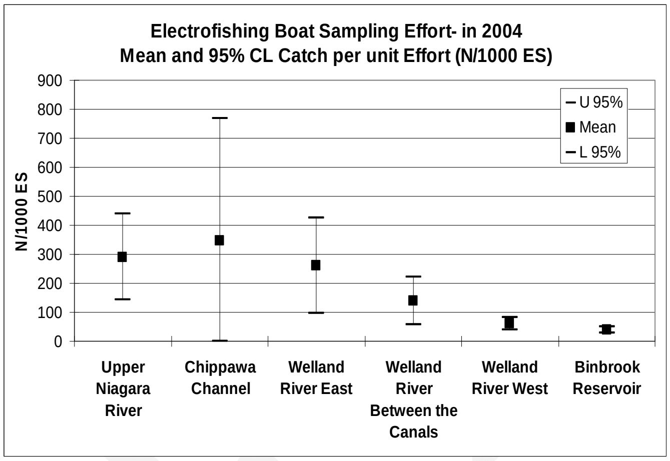


**Figure 74 Aquatic Resource Area Mean CPUEs during low flow summer period (2004) showing 95% confidence limits.**

These results re-emphasize the importance of flow augmentation to this part of the river, first recognized in the 1960's. This primary function of the Binbrook Reservoir needs to be restored. A proposed plan to realize this purpose is presented in the Discussion and Recommendation sections of this report. Additionally, instream habitat proposals are discussed for the Welland River West. Walleye were found where flow was higher corresponding with narrowing at road crossings as an example of beneficial anthropogenic habitat. Side bars of coarse substrate material have also been added in an attempt to improve spawning habitat quality (Yagi, 2007).

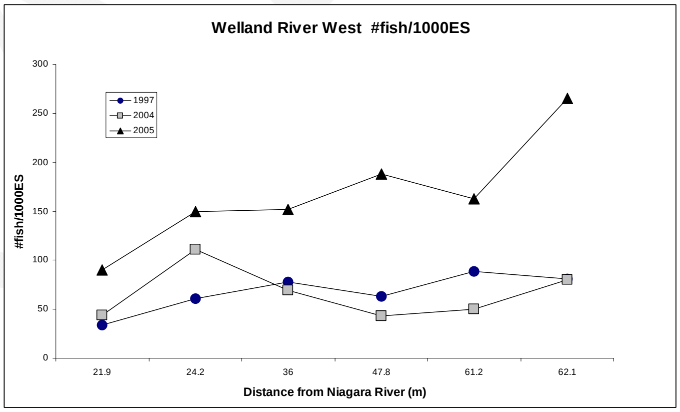


**Figure 75 Welland River West fish abundance at repeat stations showing increased abundance with greater precipitation (2005) compared to drier years.**

Distribution patterns of some species show absences through the Welland River West, which reflects poor water quality or unsuitable habitat type or both in the sluggish backwater setting. Both shorthead redhorse and greater redhorse are absent from this ARA, but present below the 4th Canal siphons and above the Port Davidson dam. Both Johnny darter and white sucker are the most tolerant species of their respective families, and they are nearly absent from the Welland River West other than in the lower 2km and the very upper portion near the Port Davidson weir where they are incidental. Walleye show a similar disrupted distribution through the middle of the Welland River West. During the summer resident sampling period 2004 and 2005, walleye were present within the first 2 km upstream of the Fourth Canal Syphons as far as Coyle Creek, and downstream of Port Davidson weir up to Oswego Creek mouth. In the summer 2007 they were also found upstream of Port Davidson Weir for a total summer range of 17.9 km.

They were notably absent over the 25.8 km between Coyle Creek and Oswego Creek. Their presence corresponds with higher water quality sites and their abundance and distribution in this ARA may be an excellent index for water quality improvement over time. Spring 2008 electrofishing shows a broader presence of the species suggesting a range contraction during the low flow season (Yagi, pers. com.) due to water quality and not habitat type. In comparison, species that are more tolerant to low oxygen and high temperature conditions show greater distribution and relative abundance in the Welland River West: bowfin, white perch, freshwater drum and bigmouth buffalo (Figure 76). The most prolific sampling results found bigmouth buffalo at 15 of 17 stations sampled in Welland River West in 2005. Presence of bigmouth buffalo in other sections of the Welland River upstream of Port Davidson and Between-the-Canals have been incidental occurrences of 1 to 2 individuals. Bigmouth buffalo have not been found in historic or recent sampling in the Welland River East or the Niagara River.

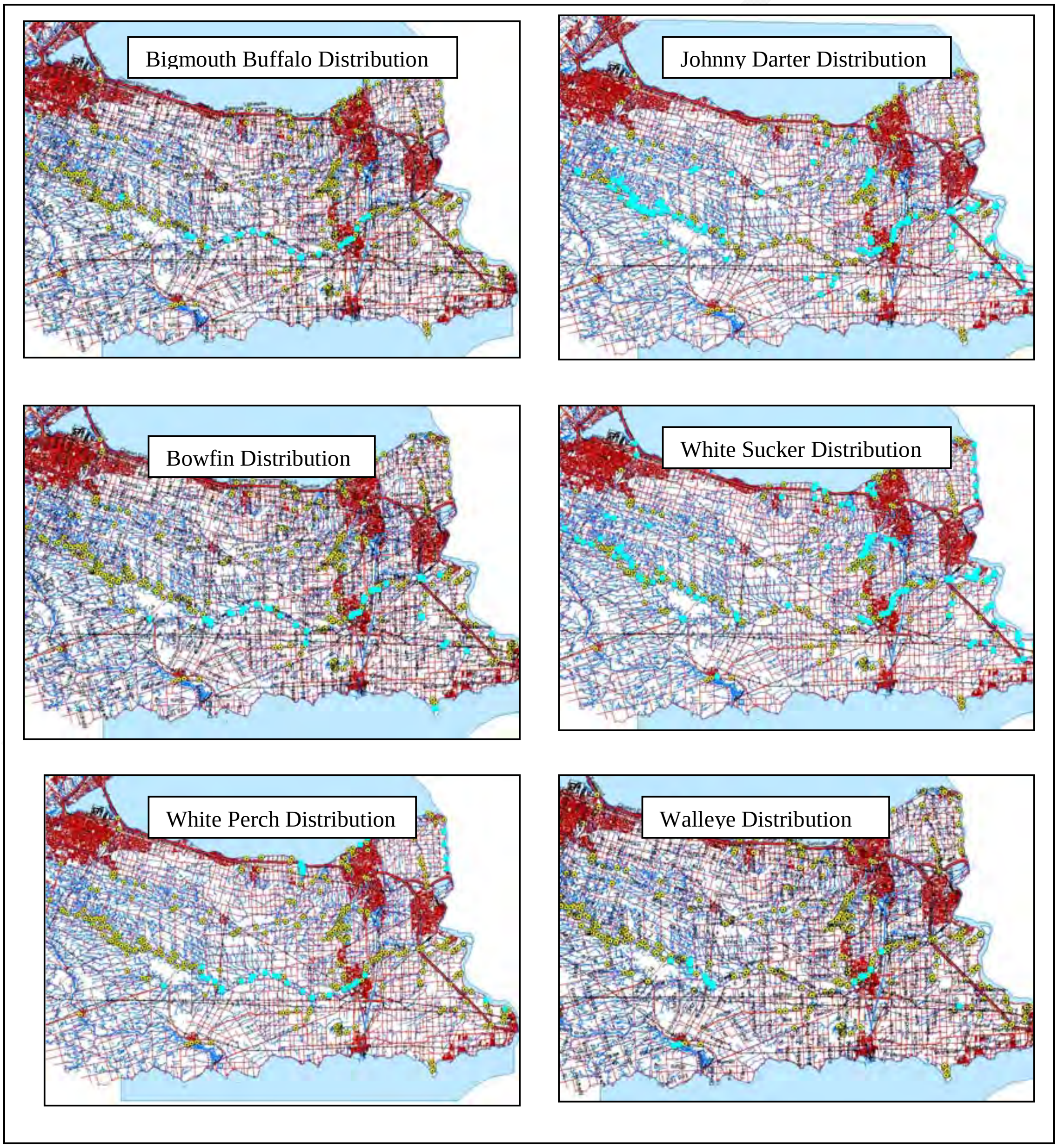


**Figure 76 Distribution of species more tolerant to poor water quality on left and species less tolerant of poor water quality on right**

### 4.11.2 Connectivity & Species Distribution

Connectivity plays an important role in species distribution and abundance. Breaks in connectivity can interrupt the timing or completely prohibit spawning migrations or migrations of thermotactic species. In those parts of the Niagara River watershed, where daily water fluctuation alters direction of flow, further complications exist for rheotactic species that orientate their bodies in the direction of flow. Where disruptions to access or flow direction exist, the presence of certain species or their progeny goes undetected during resident fish surveys. Given that stocked walleye survived in the Welland River West, it stands to reason that certain species (ie redhorse and white suckers) that coexist in the same habitat as walleye would also be present, or at least their young of year (YOY) would be present, if they had access to the same habitat. Five fish migration challenges likely exist on the Welland River main stem. They are associated with the Welland River-Niagara River confluence (Triangle Island), the New Canal Syphons, the Old Canal Syphons, the Port Davidson weir and the Binbrook Dam.

The Triangle Island is the location where the Welland River and Niagara River converge and where rheotactic and thermotatic cues are first disrupted showing an abrupt decline in about half of the abundance from Chippawa Channel to Welland River East (WRE) (Figure 77). The syphons appear to show the same affect as seen by 'step' drops in relative abundance of number of fish collected (N/1000ES) in each ARA. While a diminishing trend in relative abundance is expected in an upstream direction, abrupt drops by close to half from the Chippawa Channel WRE; half again from WRE to the Between-the-Canals, and more than half from Between-the-Canals to the WRW suggest connectivity problems on top of normal stream continuum diminishment.

Migration through the new syphons has not been directly tested. Presence of both muskellunge and periodic occurrences of large schools of emerald shiners within the Welland River Between-the-Canals suggests passage is possible from some source. However, more specific studies are required to determine whether these movements are due to upstream passage through the New Canal Syphons or entrainment from flow augmentation at the Old Welland Canal, as both emerald shiner and muskellunge are also present in the Canal.

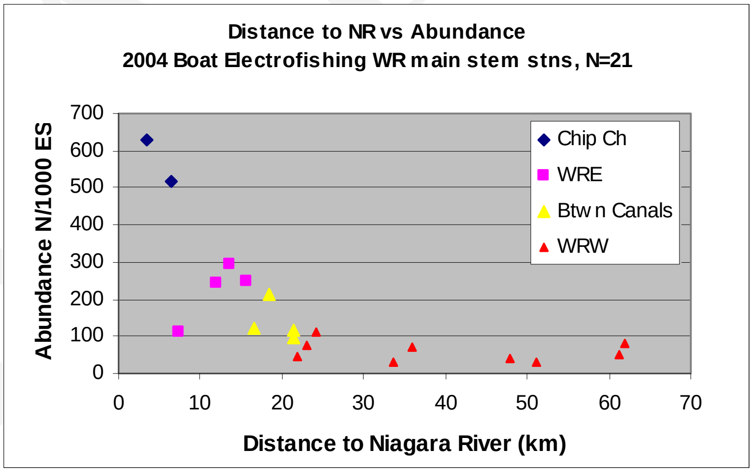


**Figure 77 Distance from Niagara River vs Abundance, 2004**

Summer data can be used to demonstrate the effect of the syphons on migration. Use of an area by migratory species is reflected in summer by the presence of YOY or juveniles of migratory spawning species, and presence of rheotactic/thermotactic species that migrate from the Niagara River into tributaries. The relative abundance of these kind of species in each of the ARA's in the summer of 2004 suggests the Welland River West is underused by these species as indicated again by large reduction in their relative abundances (Figure 79**Error! Reference source not found.**). These results can reflect a migration problem meaning the adult spawning population does not access these areas, or it can mean a water quality problem, i.e. spawners access the areas but either spawning is unsuccessful, or habitat is unsuitable to provide cover or food for progeny. (i.e. sink effect). Since neither migratory adults nor their progeny are well represented during the summer fish sampling period a definitive answer to the question of migration barriers is not determined based upon fish sampling alone. Another aspect to consider is the success of the walleye stocking program in the Welland River. Since the stocking of walleye in Caistorville resulted in a downstream dispersal into the Welland River West and past the syphon into the "Between the Canals" ARA, and walleye were successfully incorporated into the fish community then the water quality is sufficient to support similarly intolerant species during the summer resident (poorest water quality) season. Therefore these areas should also support other migratory species (a.k.a movers and dispersers) with similar water quality tolerances in similar abundances upstream of the migratory barriers. Since abundances drop significantly in upstream ARA's we have concluded that both canal syphon structures are fish migration barriers. Migration through the syphons at the fourth Welland Canal is quite likely the largest barrier to fish migration in the Welland River. The Triangle island confluence is not a migration barrier instead it interupts homing cues and is a behavioural barrier.

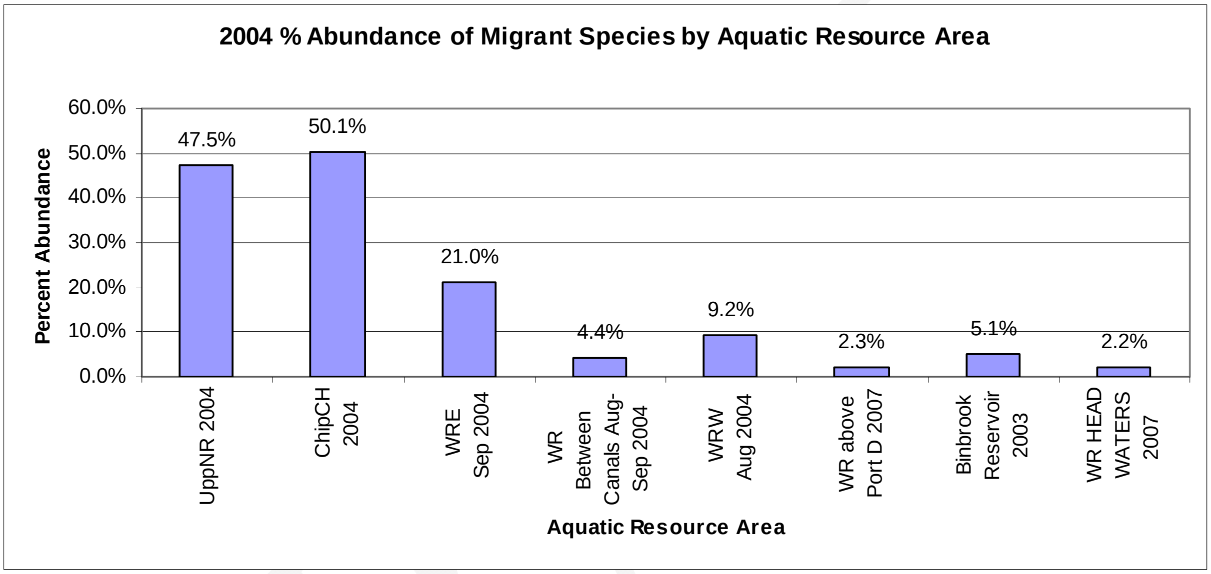
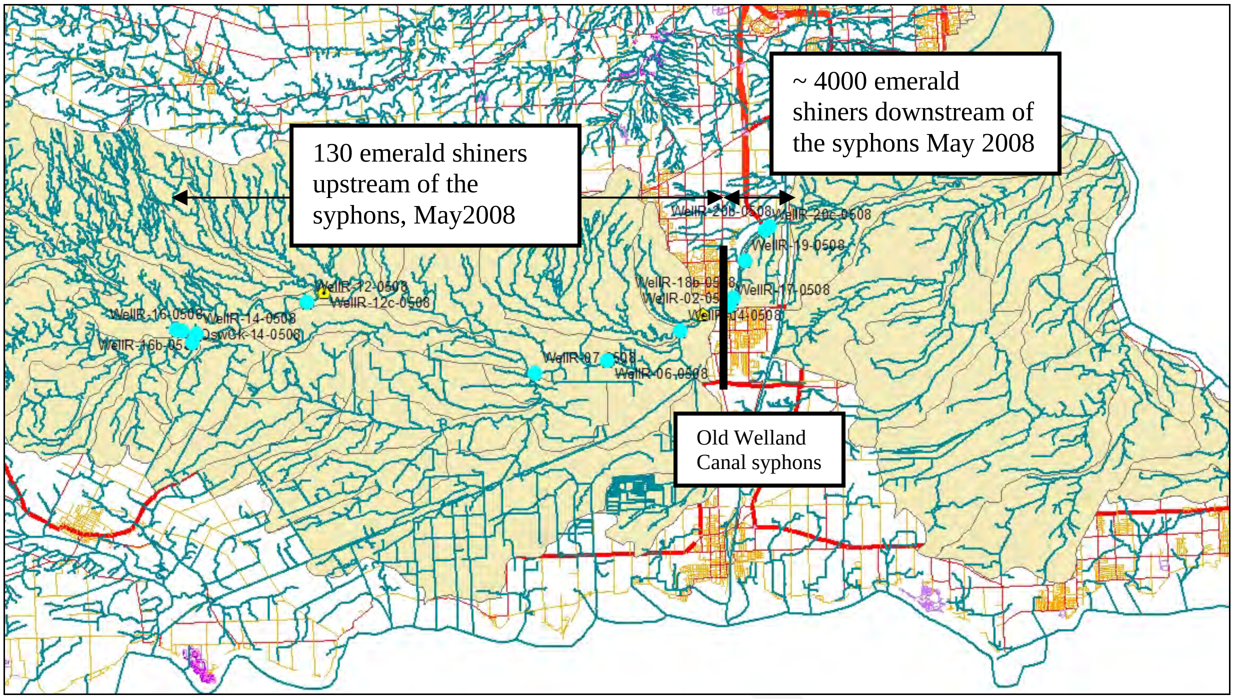


**Figure 78 Relative Abundance of Movers and Dispersers in the Upper Niagara River large body Aquatic Resource Areas (2004)**

Specific species distribution patterns support this finding. Spottail shiner is common in all ARAs below the syphons and their absence in this ARA suggest they are unable to pass the structure. Several other species' distributions show them to be in the Welland River up to the 4th Canal Syphons, but not above. These include golden redhorse, greater redhorse, muskellunge, rainbow trout, banded killifish, rainbow smelt, alewife, round goby and rudd. Distribution of emerald shiners from sampling in May 2008 shows a small abundance of minnows upstream of the 4th siphon, however it is unknown if they moved through the syphon or were entrained from the canal into the Welland River West. Relative abundance of minnows upstream were a small fraction of what is captured immediately below the syphons. In 5 stations sampled in the Welland River between-the-canals emerald shiners were collected from each station in the 5km reach, totalling 4453 individuals. In the Welland River West upstream of the syphons just 130 emerald shiners were collected from 8 of 10 stations sampled over the 30km up to the Port Davidson weir (Figure 79). Movement of fish into the river from the Old Welland Canal is likely as public reports of dead gizzard shad following spring ice melt in 2005 in the vicinity of the syphons suggest fish were being passively drawn into the river through the bottom of canal holes and not adjusting to the differences in water temperature or presssure.



130 emerald shiners upstream of the syphons, May2008

~ 4000 emerald shiners downstream of the syphons May 2008

Old Welland Canal syphons

Figure 79 Emerald shiner distribution in Welland River May 2008

The white sucker study in 2000 did not demonstrate that spawning migration through the 4th Welland Canal Syphons is likely and in these authors' opinion, considering the prolific telemetry scanning, it demonstrated the opposite; that white suckers did not migrate upstream through the syphons to spawn. A better understanding of fish spawning migration abilities through these two structures requires direct telemetry studies of pre-spawning adults with daily verification of their location through mobile scanning. Half the sample placed upstream and the other downstream of the structure to control for any bias in the assumption the fish tagged were in spawning condition. Fish tagging (mark/recapture) studies during the nonmigratory season will help determine passive fish movement; however radio telemetry will provide an unbiased assessment of this issue during both active migration and passive movement seasons.

Telemetry studies with northern pike (Biotactic, 2003) indicated neither the Port Davidson weir nor the Canborough weir was spawning migration barriers for that species. The presence of bigmouth buffalo upstream of the weir in 2007 also likely demonstrates successful passage over the weir, as this species was not found in this ARA previously. In addition, the presence in the Welland River West of walleye originally stocked in Caistorville upstream of the Port Davidson weir demonstrates that downstream dispersal mechanisms function at least at some time during the year. Further spring spawning surveys involving walleye are warranted as they are more susceptible to spawning migration barriers than northern pike.

The Binbrook dam is an upstream migrational barrier and the DU weir structure is a movement barrier during low flow seasons and possibly during spring migration. The fisheries in the reservoir and the Welland River headwaters are isolated from the rest of the river.

## 4.12 SUMMARY OF NIAGARA RIVER WATERSHED TRIBUTARIES

Multi-year sampling of the Upper Niagara and Chippawa Channel tributaries showed these systems to be very dynamic from one year to the next. There are few examples of consistency through the years in species assemblage, species diversity, species dominance and abundance values. Some of the variation can be attributed to differences in precipitation and timing of field work. Though repeat sampling was done in the same season, most of the stations were sampled in different months each year which can coincide with slightly different species concentrations. The Upper Niagara and Welland River West tributaries that had recent habitat improvements show some variation before and after completion of restoration projects (Drapers Creek, Coyle Creek, Frenchmans Creek, and Usshers Creek) (Yagi, 2007).

Thirty tributaries were sampled, most of which have intermittent summer habitat. Abundances sometimes vary 10 fold from year to year at repeat stations. In the Chippawa Channel tributaries and in Oswego Creek a huge increase coincides with sampling during 2005 when there was more precipitation through the summer season than any other year. However this was not the case in the groundwater fed tributaries of the watershed. This kind of exclusive increase narrates how influential water quantity is to the Niagara River system, especially the precipitation driven tributaries. Seasonal changes in extent of wet habitat also determine distribution of fish and result in large variation in abundance of fish within a system. Hunters Drain is the best example of seasonal variation where length of fall habitat increased 10 fold compared to residual summer habitat and fish distribution increased with length of habitat. The same annual and seasonal variation is evident in the many upper reaches of other tributaries including reaches that classified as municipal drains. Though often reduced to remant pools, these headwater areas support YOY of white sucker, largemouth bass, northern pike and grass pickerel, as well as forage fish. Summer water quality and quantity, and access are the most important factors limiting the tributary fish community.

Grass pickerel is the predominant carnivore species in the tributaries especially in Beaver Creek (Fort Erie), Black Creek and the Welland River tributaries above Port Davidson. However, grass pickerel is not well represented in the WRW tributaries or the Chippawa Channel tributaries. Introduction of grass pickerel in these areas may establish successful populations. Top predators in the tributaries also include northern pike, largemouth and smallmouth bass, and bowfin.

Tributary restoration efforts have resulted in desirable effects in Frenchmans Creek, Usshers Creek and Drapers Creek. In each of these systems there has been a shift in the species community to reflect better flowing stream conditions. Restorative work in Coyle Creek has also likely resulted in improvements to that system, but historic data is not available for comparison. Tributary restoration has thus far primarily focused on tributaries with permanent flow, or in the case of Usshers Creek, creating permanent flow. Some work has been done on intermittent tributaries to preserve, reclaim or extend the length and area of riparian areas. These efforts should continue. Where there may be no water source to tap, a well established riparian buffer can better entrap surface water, and decrease evaporation so that duration of surface water can be extended longer and possibly over a greater area. Several tributaries upstream of Port Davidson for example have only a short extent of riparian buffer near their downstream ends, and patches of riparian growth around deeper residual pools. Beyond these areas the tributaries are often incorporated into cropland. Some farmers indicated they desired a better defined channel across their fields and thus a program to re-establish riparian growth could benefit both the landowner and the resource.

Of the 5 direct Upper Niagara River tributaries, Miller Creek and Frenchmans Creek boast the greatest species diversity and the greatest number of cyprinids indicating higher habitat quality and diversity. Usshers Creek shows the highest abundance of lithophillic individuals likely due to flow augmentation from the Niagara River resulting in better cleaning of fines from the channel. The flow augmentation may also be the cause for a high relative abundance of movers and dispersers, which included both spawners (shorthead redhorse and white sucker) and rheotactic/thermotactic species (common shiner, emerald shiner and spottail shiner). These two systems may be suitable for local reference sites.

Black Creek has several metrics that suggest a need to look at details of habitat and land use practices in the subwatershed. Relative to the other Niagara River tributaries there is a high abundance of tolerant species and a low abundance of desirable species (lentic, lithophillic and high quality pool species). Also, 3 of the 4 species that were not found in recent studies were associated with creek attributes. This combination of indicators may be pointing to poor flow conditions allowing siltation in the creek through poor flushing, or conditions that arise due to erosion related siltation in the creek. Miller Creek, similar to Black Creek, has seen the loss of lithophillic, lentic and turbidity intolerant species suggesting a change in the substrate toward a dominance of finer particles. A review of these two tributaries is advised.

There is less species diversity outside of the immediate tributaries to the Upper Niagara River. Sucker and minnow diversity and abundances decrease. Within the community of “Movers and Dispersers”, the mix of large schools of common shiner, emerald shiner, spottail shiner, gizzard shad, banded killifish and the suckers are not found in Welland River West tributaries and above. Rather, these species appear as sporadic occurrences or small groupings. Three members of the sucker family are included in current surveys in the Upper Niagara River tributaries. This family is reduced to fairly incidental occurrences of white sucker and shorthead redhorse in tributaries of other ARAs. Greater redhorse, historically present in all the Niagara River tributaries is absent from all current surveys.

Species richness and abundance indicate Lyon’s Creek is the best example in Chippawa Channel tributaries, Coyle Creek is the best example of the Welland River West tributaries, and Mill Creek and Wolf Creek are the best examples of tributaries upstream of Port Davidson. These tributaries, though they still require work to improve habitat, can be temporary reference sites within each of the ARAs.

# 5 DISCUSSION

## 5.1 THE NIAGARA RIVER SYSTEM

The fish community of the Niagara River system includes species that live their entire life cycle in either the mainstem or its tributaries and those species that move back and forth from the river to the tributaries to meet a specialized part of their life cycle. Both tributary and river species comprise the biotic diversity of this system. When the system is functioning under natural variables both tributary and river populations contribute to the dynamic sustainability of the system. Fish populations are usually not stabilized at a magic value but vary in numbers and abundance created by the natural variables acting upon this system. In the case of the existing Niagara River system there are both Natural Variables and Anthropogenic Controllers acting on the fundamental values or attributes of fish habitat. These attributes form the amount and quality of fish habitat that the Niagara Fish Community occupies at any given time and affect the overall abundance and diversity of fish measured during our study (Figure 80).

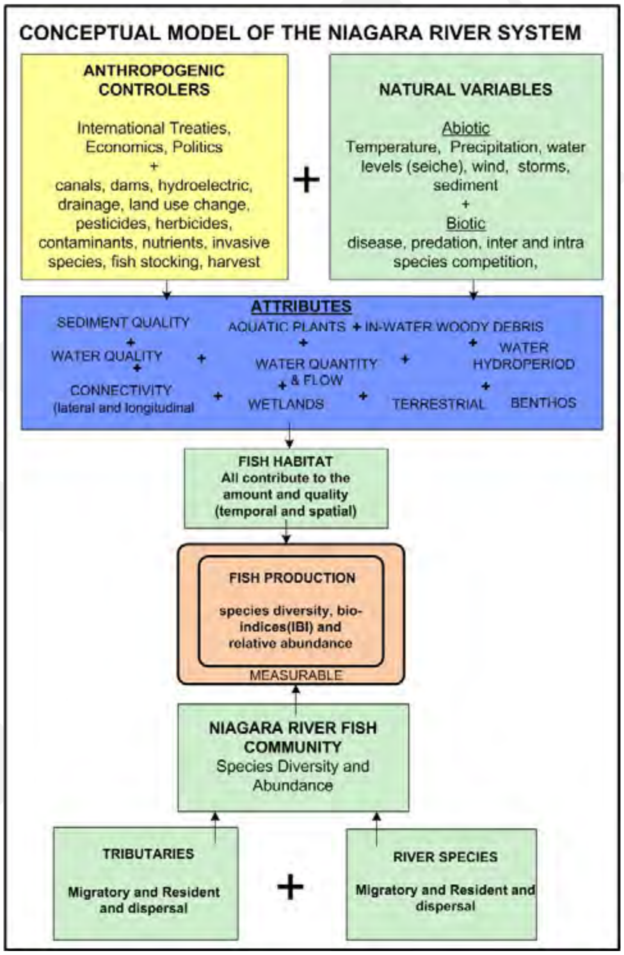


**Figure 80 Conceptual Model of the Existing Niagara River System**

To characterize the fish community, nine sampling seasons occurred within the 15 year fish assessment period which included extreme periods of drought, flooding and “more usual” precipitation events. Sampling results were averaged and standardized by method of capture and effort. The resultant values for species diversity and abundance are a direct reflection of the amount, distribution and quality of fish habitat in the watershed, which is in turn a reflection of both the anthropogenic controllers and natural variables acting on this system (Figure 81).

The measured qualities of the fish community such as the distribution and abundance of certain fish indicator species provides direct evidence that anthropogenic controllers are dominanting the fish community attributes of the Niagara River watershed. For example the distribution of the white sucker (*Catastomous commersoni*) is greatly diminished upstream of the Welland Shipping Canal as is all redhorse sucker species (*Moxostoma sp*.). Suckers are widely distributed species in the Great lakes and are both rheotactic and anadromous, which means they respond to flow indicators and move upstream from large waterbodies to tributaries to spawn. Another example are cyprinids (non carp and goldfish) known as minnows, which are ideal soft bodied forage for piscivorus species and are also diminished in diversity, abundance and nearly absent from the mainstem Welland River West. The emerald shiner (*Notropis antheroides*) is a rheotactic and thermotactic schooling species which responds to flow and temperature stimuli, and readily moves en masse into smaller tributaries which warm up faster in the spring for feeding and avoidance of colder temperatures in the Niagara River. Emerald shiner is nearly absent in the Welland River west which is ideally suited in terms of space and temperature.

Another example is a functional response of the fish community to the re-introduction of walleye in the Welland River. Prior to this species re-introduction, the Welland River West fish community was dominated by fish species such as carp, bigmouth buffalo, bullhead and channel catfish that are tolerant of low oxygen, high temperature, high turbidity and high nutrient content. This fish community changed after stocking walleye, which is a dominant piscivorous species that prefers turbid, moderate temperatures and moderate oxygen. Total sportfish composition increased and total carp/catfish/bullhead decreased. The walleye’s summer distribution was void within the areas that showed the worst water quality and present in areas of better water quality (Yagi and Blott 2009, NPCA, 2010). In the areas of poorer water quality where walleye were absent the dominant fish community remained the same as prior to stocking of walleye. In addition, since stocking, walleye have dispersed into all sections of the Welland River mainstem and have been found spawning in areas of best diversity of habitat. It is unknown at this time whether walleye that have dispersed downstream through the syphon structures can actually move back upstream during a spring spawning migration. Given the complexity of the strucutures and the fact that telemetered white suckers did not move through during the spawning migration (Yagi and Blott, 2009) it is unlikely that walleye will be able to either. This means that when the water quality diminishes in the Welland River West, walleye that disperse downstream from these areas cannot get back to spawn and therefore it is likely that stocking will need to continue inperpetuity without correcting migration barriers at the canal crossings. In the absence of these controllers, walleye produced in the Welland River could disperse freely and contribute to fisheries within the Niagara River mainstem and walleye from the Niagara River could move back into the Welland River for spawning and rearing functions.

Productive fish communities with a diverse assemblage of species will assimulate available nutrients into a complex food web thus locking up excessive nutrients for a longer period of time. Therefore in the presence of a complex food web, short term periodic and undesirable algal blooms and blooms of duckweed will diminish and water quality will improve. If fish produced in this watershed are harvested for consumption, populations need to be able to sustain the harvest to be self maintaining. However, harvest is a desirable function of a productive fish community because harvested fish remove nutrients (nitrogen, phosphoros, potassium) from the watershed altogether. Therefore a productive fishery that is self sustaining with harvest over time helps to maintain a desired water quality.

In reality having both controllers and natural variables acting on a fish community is analogous to a body with "two-brains". The functions of the body would work best if there was one controller directing it or "one body with one brain." Theoretically, if the controllers were functioning as close as possible to natural variables then there would be "one brain" directing the "body" resulting in a positive outcome. In the case of the Niagara River fish community, anthropogenic controllers have interrupted natural processes of migration and spawning as well as habitat quality and are therefore limiting the overall fish productivity of this watershed. This is evident in the most controlled areas of the watershed (Welland River upstream of Port Robinson channelization, Welland River West, all tributary interfaces with the Welland and Niagara Rivers) and less evident in areas that are least controlled (Welland River Headwaters, tributaries upstream of the GIP elevation influence). Therefore habitat restoration projects need to be prioritized in the areas where Controllers are having the most harmful effect on the fish community.

Results of the fish community sampling indicate several measures are needed to reduce negative effects of anthropogenic controllers and they fall under 3 general categories:

1) Water level controls for Hydroelectric Production and Tourist Aesthetic values
2) Improve flow, physical habitat and connectivity in the Niagara River tributaries especially upper Niagara River creek interfaces/estuaries and the Welland River West, and
3) Continue restoration work and riparian reclamation in Niagara River and watershed tributaries.

## *5.2 WATER LEVEL CONTROLS*

The simplest solution from an ecological standpoint to mitigate anthropogenic control of water levels is to operationally stop controlling them. If a steady flow is taken for hydroelectric production all day, all night and all year with storage only occurring off line in the Queenston Reservoir/Power Canal system, the excess spill over would be going over the falls for tourists (who would see less water over the falls). The the only change in waterlevels in the upper watershed will be from natural variables such as storm events and lake seiches. Hydroelectric operations are controlled by an International Joint Comission (IJC) treaty between Canada and the United States to allow more water taking at night than during the day to maintain an aesthic quality of flow over the falls for tourists. This agreement was created before a complete understanding of ecological effects of daily fluctuations and flow reversals, and how these effects would alter the upper watershed habitat, fish community, water quality and aesthetic quality of the shoreline. Changes to water control management warrants review.

## *5.3 WELLAND RIVER FLOW CONTROLS*

The Welland River needs ecologically based flow augmentation to offset anthropogenic controllers operating in the watershed. At the present time controllers add flow from Lake Erie at the Fourth Welland Canal siphons, again at the water treatment plant, again at the sewage treatment plant and again through Lyon's Creek East. Also Grand River flow is added through the Feeder Canal. Groundwater flow and storm flow from the upper watershed is captured in a reservoir and released back to the river in a controlled manner and only when water is plentiful (Figure 82). The natural flow in the extremely-low-grade, predominantly precipitation driven system is inadequate in volume to offset reverse flow dynamics caused by the Lake Erie and Grand River water introductions and the daily water level fluctuation and controls associated with hydroelectric generation. Flow is particularly backed up in the Welland River West outside of the spring and fall periods when melt water, groundwater and precipitation contributions are at their lowest.

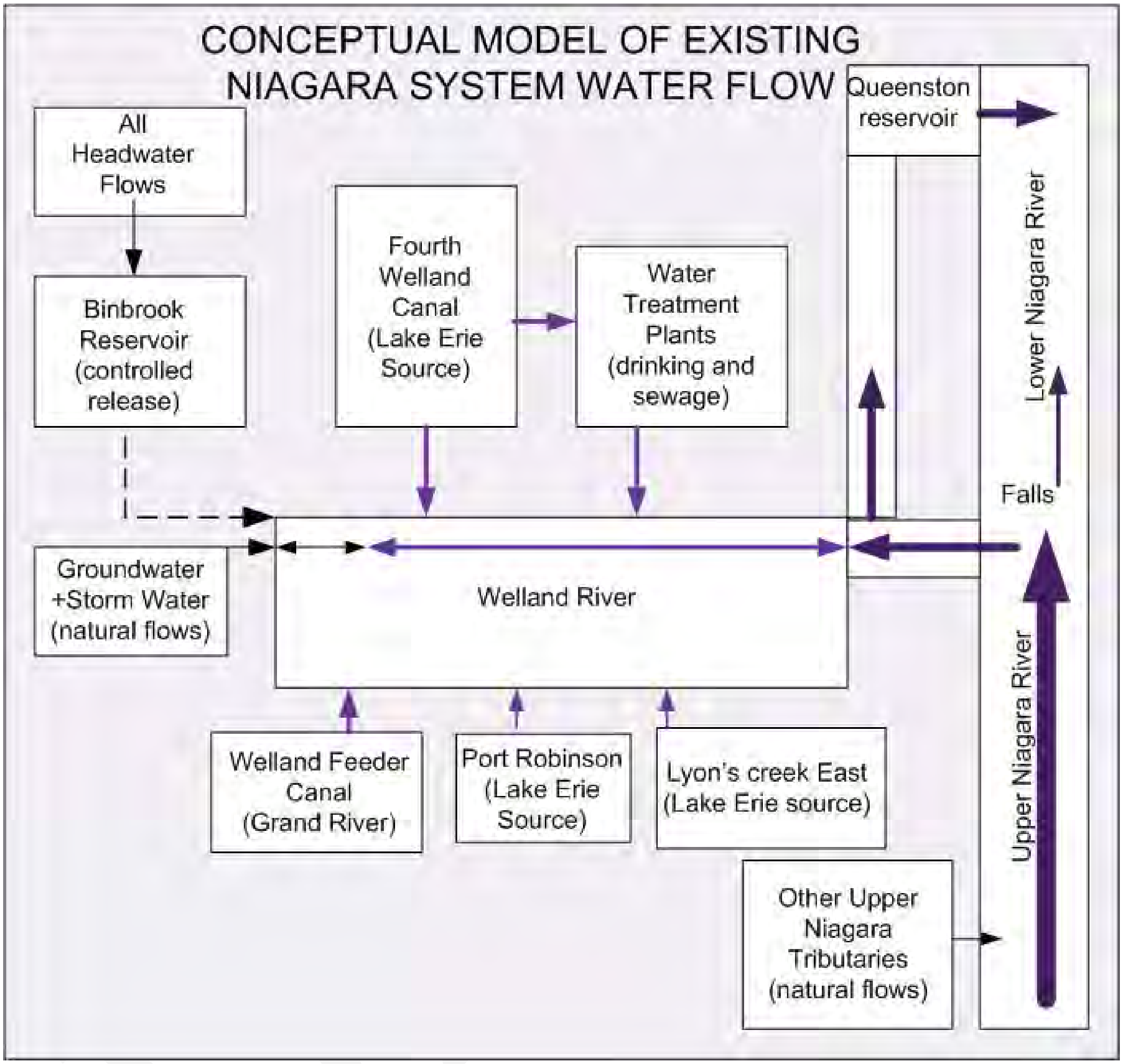


**Figure 81 Existing Water Flow Model for the Niagara River System**

Without flow augmentation, the watershed would revert to natural precipitation and flooding events with groundwater baseflow contributions. This would be an acceptable scenario if water levels were also not controlled and people no longer relied on the river as their sewage outfall. In the scenario of natural flow conditions, the resulting active flow channel of the river would be much narrower and shallower with wide margins of emergent wetlands along shore. Upper sections of the watershed above the Niagara River elevations would see marshy pools of water in tributaries without base flow and intermittent tributaries would dry out during drought conditions. As Lake Erie and Niagara River water levels rise in the spring or when the lake seiches occur, a backwater would create flooding conditions in the Welland River upstream of Port Davidson which would gradually return to lower levels when downstream flows recede. This flooding cycle would happen seasonally and not daily as it does today and would be a natural ecological cycle. However, given the social importance of the river, this “natural scenario” may be an impossible and unrealistic a goal to achieve. Flow augmentation to boost water quantity and quality is therefore still desirable.

A realistic and desirable goal is to operate or change the flow controllers to meet ecological objectives of the Niagara River fish community. This means prioritize projects at 3 ecologically critical junctions (Figure 83). Two of these junctions (Triangle Island, Fourth Canal) disrupt migration behavioural cues of rheotactic fish species such as suckers, walleye, northern pike and the thermotactic behavioural cues during the spring movement of emerald shiners from the Niagara River into tributaries. The third control point is the operating regime of Binbrook Reservoir.

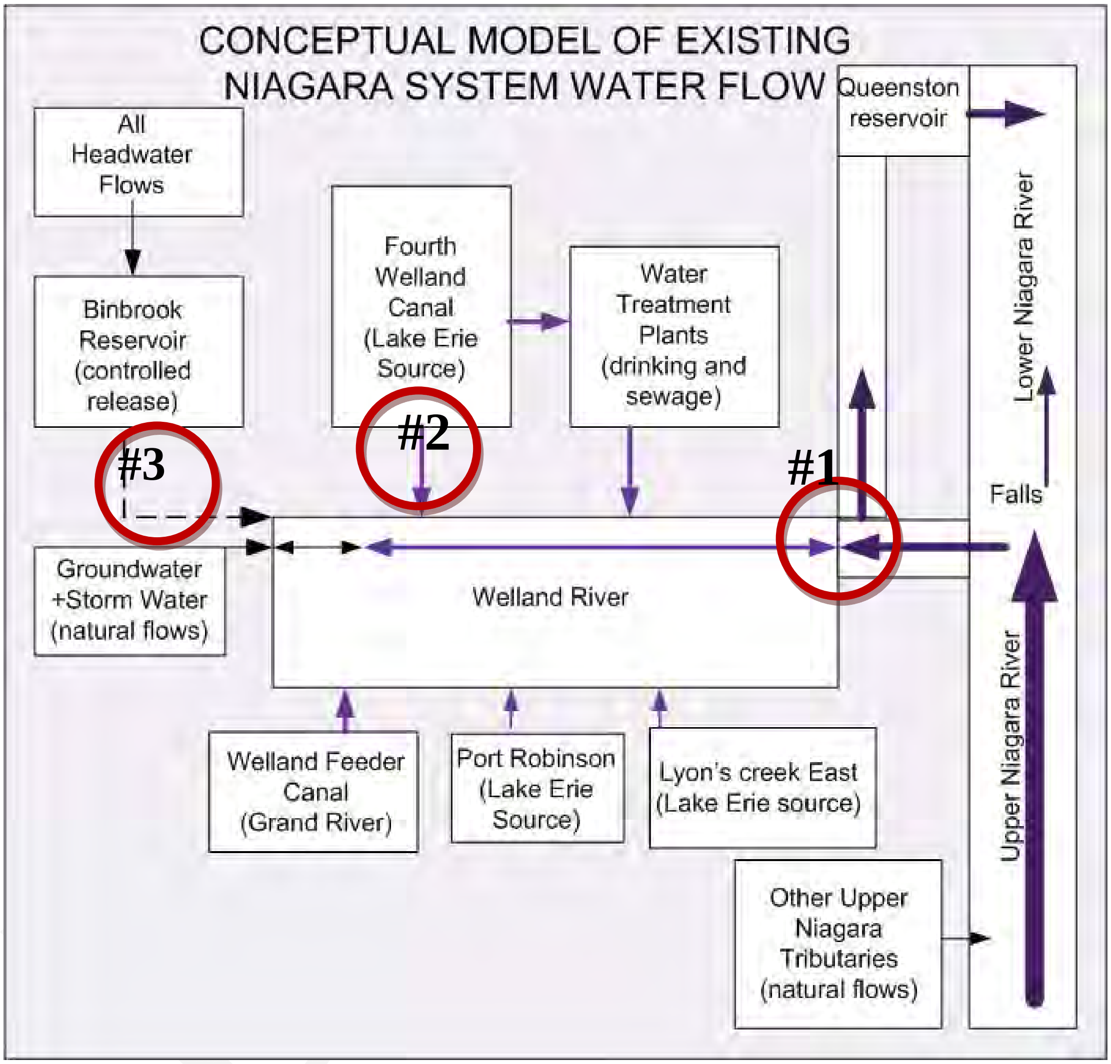


**Figure 82 Conceptual water flow model depicting 3 ecologically important water flow controlling junctions that require remediation. #1 Triangle junction; #2 Fourth Canal siphons; #3 Binbrook reservoir operations**

### 5.3.1 Triangle Island Flow Junction

Niagara River flow meets with Welland River flows at the confluence with the Power Canal and Chippawa Channel. A triangular island of land, marks the junction of water flows forming a water channel on all 3 sides. Eary spring aerial photography shows Welland River flow that is markedly turbid brown (red arrows in figure) and the Niagara River flow which is visibly greenish-blue (yellow arrows in Figure 83). Flows converge in this complex area in the least desirable location from an ecological standpoint. The majority of Welland River flow is diverted to the west portion of the triangle, thereby directing the flow and thermal cues northward into the Power Canal which has very high flows. This configuration is undesirable to attract river species into the Welland River because Niagara River fish (smaller sized fish would be most affected) are likely to be entrained into the faster waters of the Power Canal and swept downstream before they detect and maneuvre into the Welland River. This configuration also effects fish swimming out of the Welland River toward the Niagara River. Although no studies have been done to measure fish entrainment within the Power canal, the flows here exceed critical sustained fish swimming speeds for a wide range of sizes and species (Phillips, 2003). Once fish enter the power canal, it is unlikely they are able to swim back upstream against the strong Power Canal flows. Additionally, smaller fish that are sucked into the pump system that fills the Queenston Reservoir are lost entirely to the river system. In 2011, the Queenston Reservoir was completely drained for the first time since it was constructed (circa 1958). During the de-watering exercise attempts were made to relocate, count and speciate all fish residing in the reservoir and a total of 8696 fish were captured comprising 25 species. This study provides direct evidence of fish entrainment into the power canal and reservoir but does not define a time scale to determine a rate of entrainment (OPG and Golder 2011). This entrainment of fish creates a loss in Niagara River productivity and an ecological disconnection.

The fisheries goal in this watershed is to attract spring time Niagara River fish migrations into the Welland River tributary and not into the Power Canal where fish productivity is lost. Phillips Engineering looked at the issue of water level controls in this area to mitigate the daily flux control in the upstream watershed and concluded a project here was not feasible as all solutions would block connections and be problematic for boating and were cost prohibitive (Phillips 2003). However the focus of the project was on controlling the GIP daily flux and not on ways to attract fish from the Niagara River into the Welland River during the spring season.

If all Welland River spring flows met Niagara River waters in the southern portion of the triangle then fish could be attracted (through flow, turbidity and temperature cues) before they were entrained and lost into the Power canal diversion. This could be done by blocking the Welland River flow from the west portion of the triangle confluence and direct it toward the southern channel forming an estuary area. This project would not affect boating because no boats are allowed within the east or west channels of the triangle. An analysis of flow volumes will dictate the location of the berming and whether the south channel should be physically altered to accommodate an ecologically appropriate confluence. Any improvement in attracting Niagara River fish to find the Welland River instead of entrainment to the Power Canal would benefit the overall fish productivity for the Niagara River Watershed (Figure 84).

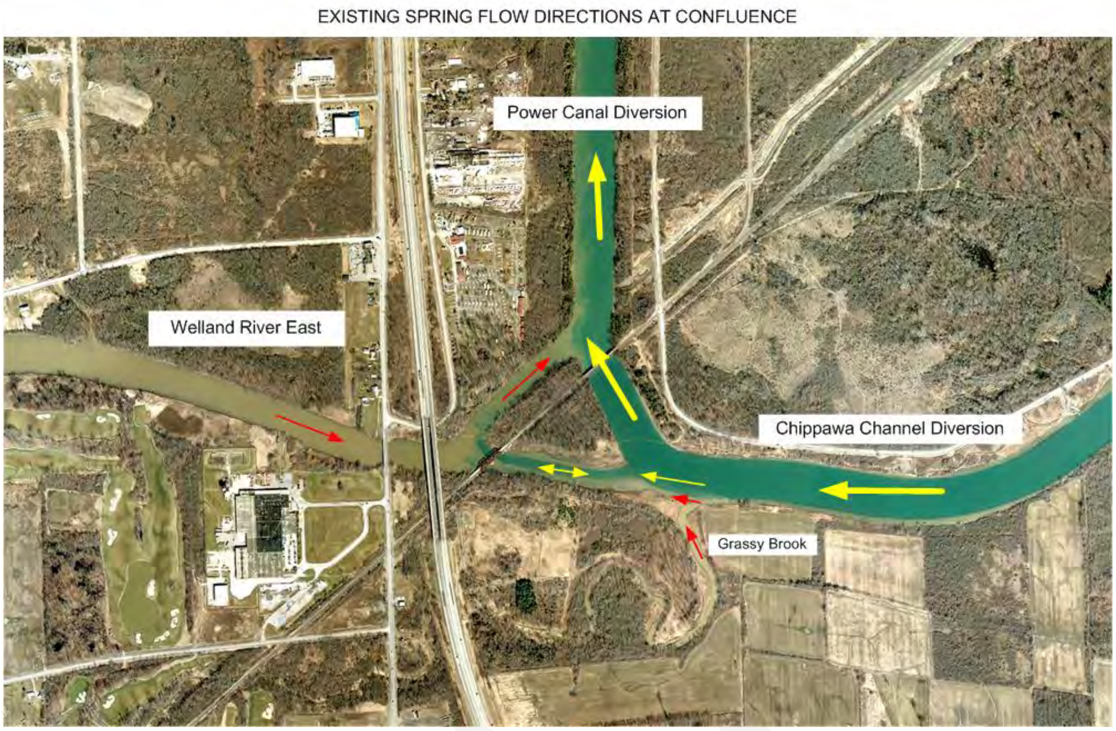


**Figure 83 Confluence of merging waterflows in this triangle area depicting the pattern of spring flows from the Welland River East, the Chippawa Channel and Grassy Brook Creek.**

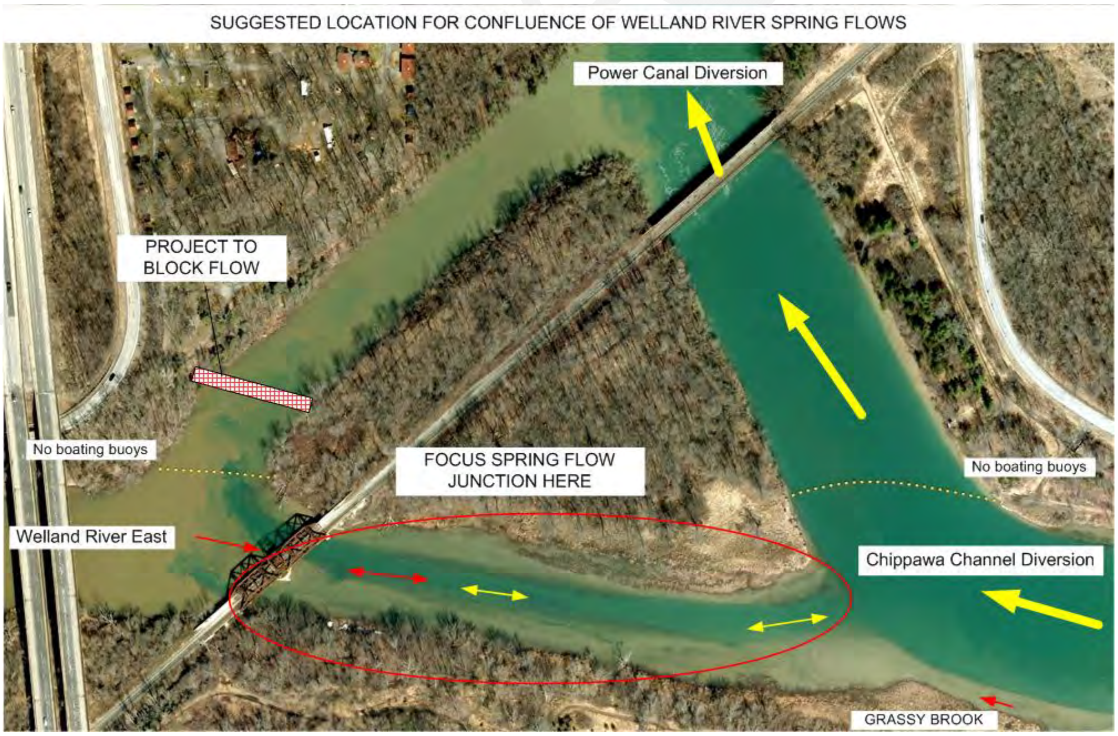


**Figure 84 Close up view of suggested location for Welland and Niagara River delta. West channel flows from Welland River blocked to improve rheotactic and thermotactic behavioural response in fish community during spring migration season**

### 5.3.2 Old Canal Syphon Structure

Flow augmentation from Lake Erie is desirable, because lake water quality in terms of turbidity, temperature and nutrients is of much better standards all year long compared to water within the Welland River (NPCA 2010). However, the present connection is at the bottom of the Old Canal through holes in the top of the siphon pipes. This configuration adds to the complexity of flow and temperature patterns in the area and impairs the rheotactic (flow attraction) and thermotactic (temperature attraction) cues and the natural behavioural response of fish to these cues. Fish are confused by turbulent flows and cold temperatures during the spring migration period. Without the addition of canal water at this juncture, the relatively warm water of the Welland River flowing downstream will increase the likelihood a fish will migrate through this siphon structure. During the spring 2008 walleye spawning survey the Welland River West was 10°C warmer than the Welland River Between-the-Canals (which includes flow augmentation from the canal). This temperature difference dictates an earlier spawning run in the upper watershed compared to the watershed below the point of flow augmentation. Temperature data was supported by the presence of spent individuals in the Welland River West compared to walleye still in spawning condition downstream of the siphons (MNR unpublished data). Therefore to realize all the ecological benefits of flow augmentation from the canal, the flow entry point needs to be separated from the siphon structure and the same amount of flow introduced into the river approximately 3.5km upstream of the siphon. No changes are proposed for the intake to the Water Treatment Plant or Sewage Treatment Plant discharges so the amount of water available for dilution of sewage treatment flows will remain the same. To facilitate the furtherest upstream discharge location and to not create large temperature differences, a surface water connection only should be used via a passive flowing gravity fed pipe or open water course (ditch). Suggested locations to discharge Lake Erie water from the Old Welland Canal to the Welland River could use in part existing open watercourses, ditches, the Feeder Canal and Brown Tap Drain and/or a new enclosed pipe are shown in Figure 85.

**Figure 85 Possible routes for connections from Old Canal & closure of existing connections at syphons.**

### 5.3.3 Binbrook Reservoir

Recent spring surveys (May 2008) show that fish species intolerant of high nutrients, high temperature and low dissolved oxygen have a wider distribution through the Welland River West when flows are high and temperatures are cool or moderate (A.Yagi, pers. com.). On the other hand, during the summer low flow season, several intolerant species show a confined and disrupted summer distribution through the Welland River West. This coincides to the low flow period where there is insufficient watershed flow contributions to overcome introduced upstream flows at the canals and water level controls from hydroelectric production that cause reverse flows. During the summer season, intolerant species are displaced by species tolerant of high turbidity and temperature conditions. Intolerant species are found concentrated in areas with the best habitat conditions and therefore more susceptible to predation and over harvest.

Poor water quality in the Welland River was first reported in the 1960's when uncontrolled sewage discharges caused widespread fish kills. The Binbrook Reservoir was designed to help offset poor water quality conditions by augmenting flow to the river during summer and winter dry periods. Over time this focus has been replaced in part with a management plan to hold a minimal water elevation in the reservoir for recreational purposes resulting in zero discharges in some drier years. In order to resolve ongoing water quality issues in the Welland River, the low flow augmentation needs to be resumed and the reservoir connected back to the river system. Ongoing flow monitoring is needed to determine the amount of low flow augmentation needed to maintain fish habitat in the Welland River downstream of the reservoir. Theoretically, the reservoir, or a portion thereof could be managed as a large naturalized floodplain pool (Figure 86).

This concept requires the reservoir to act like a large floodplain pool which fills and releases with the natural precipitation cycles of the watershed. In doing so, other associated functions – a gradient of riparian growth and ephemeral amphibian habitat for example, could also be successful. During the fall to spring period the reservoir would fill with rain and melt water. Much of the water would be released during the spring spawning season (March through May) and by the end of May the reservoir area would be partially drained allowing floodplain vegetation to thrive around the higher elevation edge. Through the summer the remaining water would be released to augment flow in the receiving river and, within the reservoir, allow for growth of vegetation suited to the longer inundation. There would be no minimum water level maintained in the reservoir. The summer release could result in only a small channel remaining in the reservoir, or complete drying of the reservoir, depending on the precipitation patterns through the year. In fall the reservoir may partially fill again with increased precipitation, possibly providing some storage for release again during the winter low flow period. But by late winter, the reservoir would be empty and have its full capacity for spring freshet/storm storage again.

Flow to the river out of the floodplain pool reservoir could be controlled passively by means of a slot weir that diminishes the area of flow with diminishing water elevation in the reservoir. The discharge channel from the slot weir would ideally be a long low gradient notched rock weir extension, similar to the weir modification installed at the Port Davidson weir. This combination of slot weir and discharge channel could allow for fish movement both in and out of the reservoir with changing flow patterns. Movement out of the reservoir with diminishing flows is particularly important so as not to result in stranding. The reservoir would look and behave like a large floodplain pool with an outer edge of hydrophilic tree species such as green ash, swamp white oak, bur oak and silver/red maple. As the elevation drops inward in the reservoir, successive rings of vegetation types would grow in the gradient of wetter and wetter conditions. This kind of ring growth defined by receding water and soil inundation duration would be similar as that seen in natural floodplain pool systems. Engineering assessment would be required to determine the configuration of the slot weir and discharge channel, and the size of the floodplain pool required. It is possible that the entire reservoir downstream of the Ducks Unlimited (DU) weir may be needed to successfully reinstate an appropriate summer flow augmentation plan for the Welland River (Figure 87). However, concentrating available water towards just one resource (the river) will result in a greatly improved river ecology rather than having the two compromised systems (the river and the reservoir) that we have today.

The reservoir currently functions as a park facility with swimming, boating and fishing opportunities. Recently fish were examined by Ministry of the Environment (MOE) for contaminants and found to have PAHs and mercury levels restricting human consumption. By returning the reservoir to a flow augmentation facility first and foremost, fish consumption issues, boating and swimming components would be eliminated. Fishing opportunities would remain above the DU Weir and within the river. However, this management direction would need to be examined carefully by NPCA, taking into account all past, current and future uses of the reservoir.

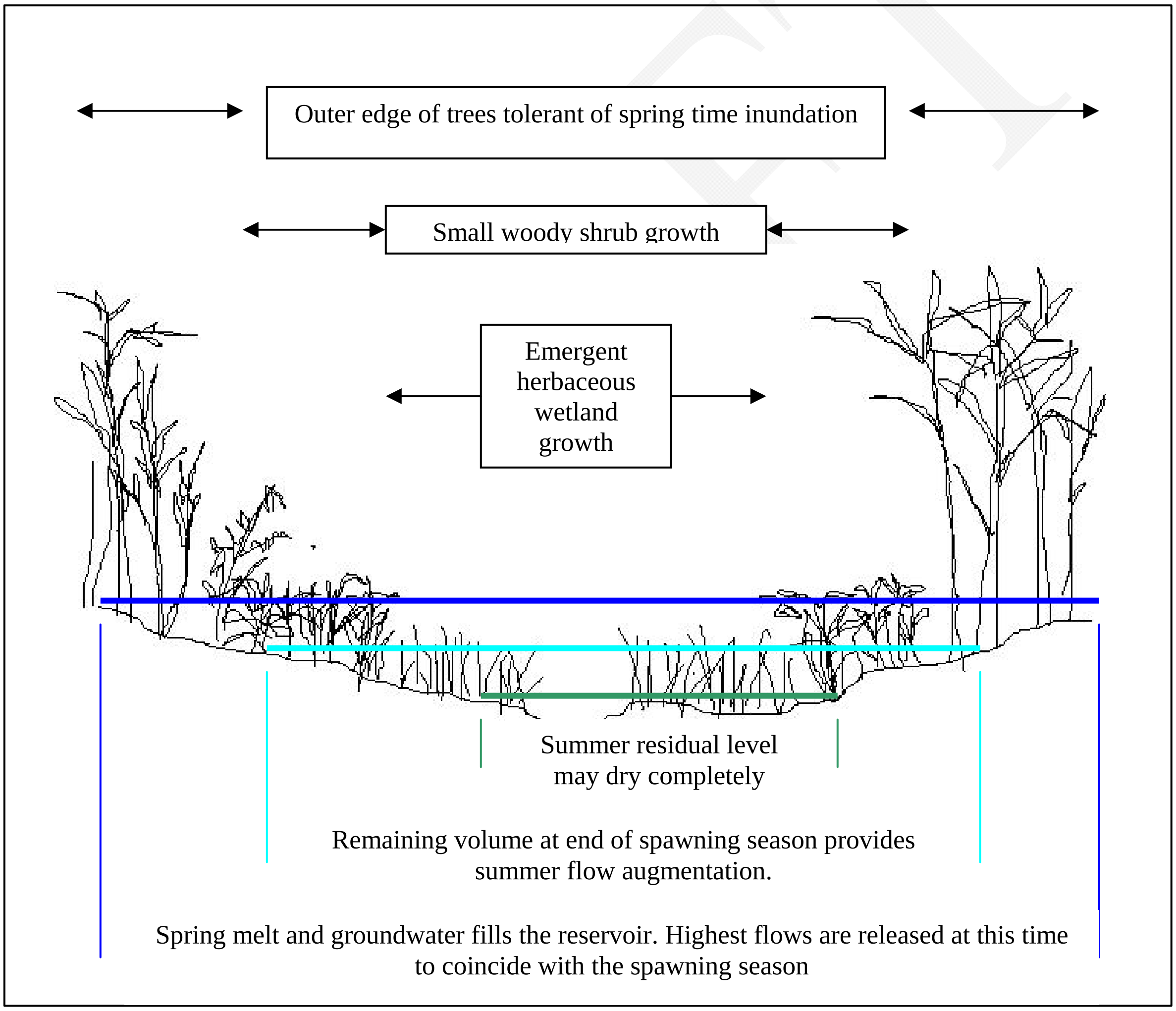


**Figure 86 Schematic of vegetation gradients in a floodplain pool reservoir**

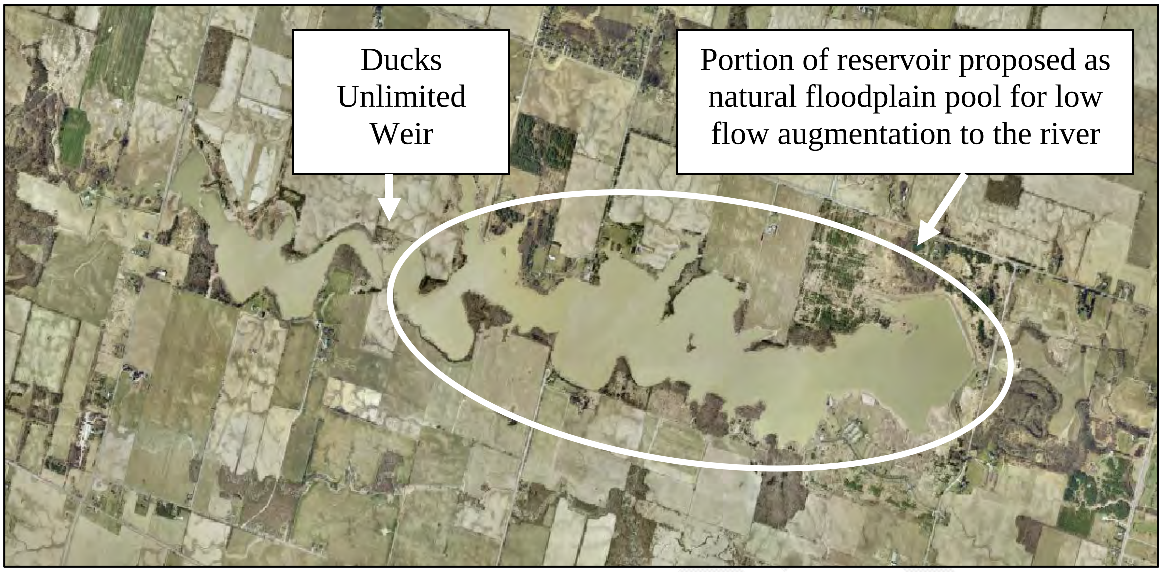


**Figure 87 Binbrook Reservoir showing the portion below DU weir proposed for natural floodplain pool management and low flow augmentation to the Welland River**

## 5.4 CONNECTIVITY CONTROLLERS

There are signs of disruption to migration patterns in the watershed primarily associated with the confluence at Triangle Island and the Old Welland Canal siphons, though there may be some limitation to movement at the New Shipping Canal siphons. Ongoing spring fish surveys demonstrate that migratory species (white sucker and emerald shiner for example) are present in large quantities in the Welland River Between-the-canals, they are essentially absent in the Welland River West suggesting passage through the siphon structure is not occurring beyond a random or incidental level. Summer survey results also indicate that, unlike downstream ARAs, the Welland River West species assemblage remains constant from year to year indicating isolation from transient schools and species that are captured in tributaries with direct access to the Upper Niagara River. While further studies may be warranted to better quantify the affects of the siphons to fish movement, the data thus far already makes a clear statement. Discussions need to take place as to a design modification that will remediate the barrier issues.  One potential remediation is to install a straight pipe that allows the Welland River water to pass straight through the canal, rather than pass under it, as there is no longer commercial traffic through this canal. Pipes could be built integral with the current bottom of the river to allow shallow recreational craft movement over top (Figure 88).

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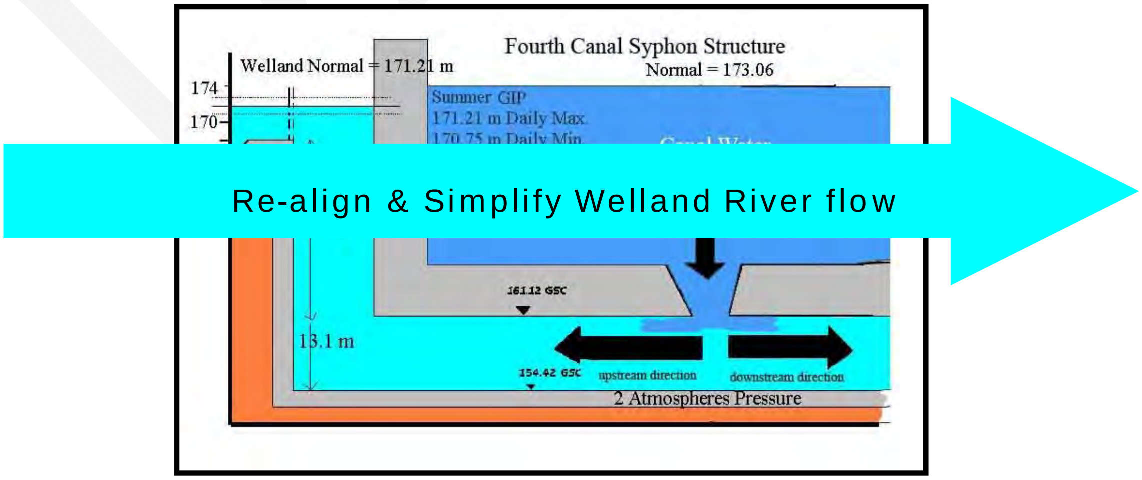


**Figure 88 Suggested elimination of Old Welland Canal Siphons**

## 5.5 INSTREAM HABITAT RESTORATION

### 5.5.1 Upper Niagara River Tributaries

Almost all of the tributaries that interface with the Upper Niagara River are biologically disconnected with the river (Section 2.4). A shallow low gradient riffle located at the interface of creek and river will act to mitigate erosion casued by daily water level fluctuations and provide an environment for aquatic wetland plants to thrive upstream and still allow for fish spawning migration and dispersal functions (Figure 89).

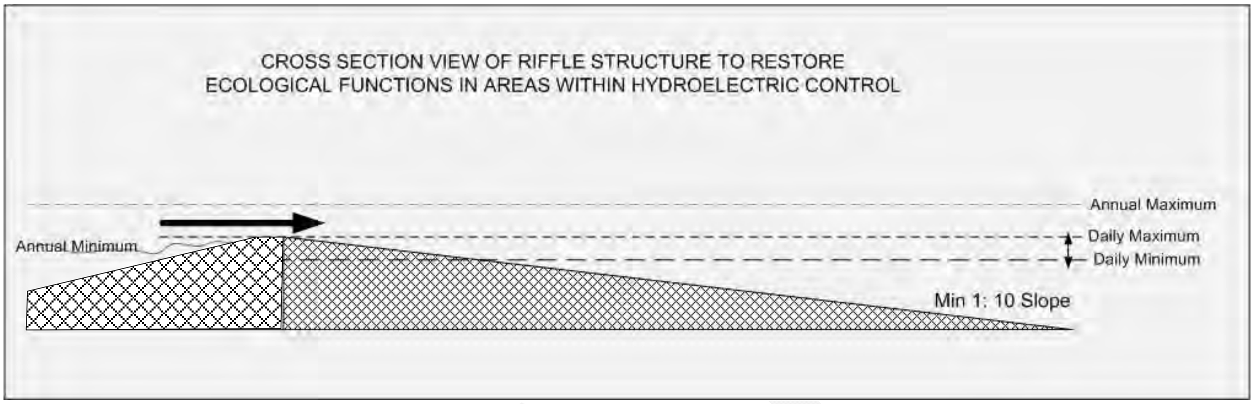


**Figure 89 Cross section of proposed riffle structures placed in the outlet areas of small creeks where they intersect Niagara River flows within the GIP controlled elevations. Conceptual design originally proposed by Dr. R.J. Planck for Ussher's Creek and Grassy Brook Creek mouths.**

This design is suitable for small creeks that are not navigable such as Baker Creek, Ussher's Creek, Boyer's Creek, Frenchman's Creek and Miller Creek. The riffle extends across the entire width of the channel and downstream to river and is only as high as the maximum GIP daily water level. The elevation is the controlling varaibale and therefore the size of this structure will be smaller the further away from GIP. Overtime the structure will be barely noticeable. If the water level fluctuations were operationally eliminated as a management measure, these smaller creek mouths would likely re-establish wetland estuary habitat on their own not requiring any modifications.

### 5.5.2 Welland River East

**Port Robinson Bypass Area**

The Welland River east was channelized in the 1970's to accommodate the new shipping canal bypass (Secton 2.2.1). An engineered straight channel was constructed with a narrow littoral zone on each side of the channel similar to the canal although not as deep. No fish habitat features were included in this design. In addition a portion of the original river channel was kept in tact and flow was augmented to maintain fish habitat functions. The habitat within this remnant channel is too wide for the amount of regulated flow and has degraded over time being cut off from upstream sediment supply and woody debris (Figure 90).

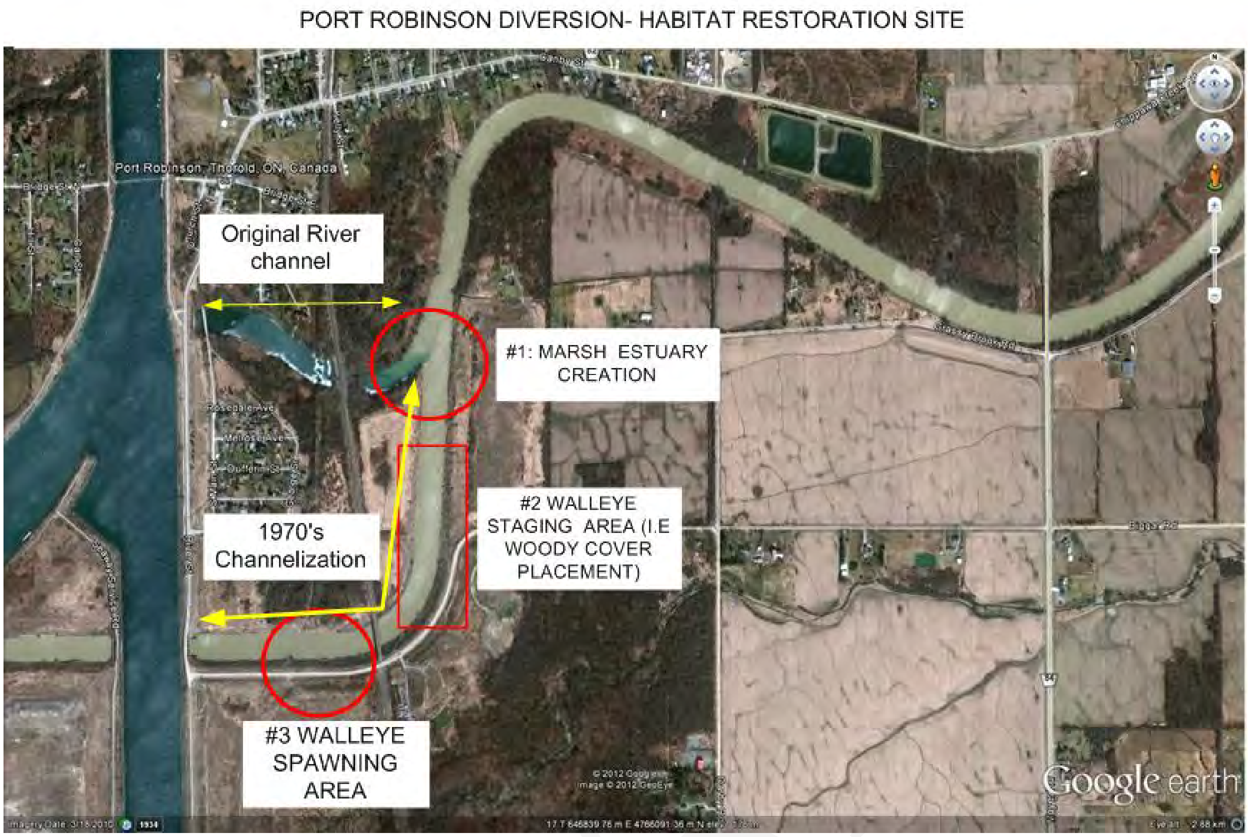


**Figure 90 Locations of proposed fish habitat enhancement and restoration sites withn the Port Robinson Diversion channelization and old channel flow augmentation area**

Project #1: A marsh estuary enhancement project is recommended where the old channel meets the river. Using either a rock riffle structure to mitigate daily waterlevel flux or by extending the point of land with a series of shallow rocky berms along shore to narrow down the oulet area to promote sedimentation and emergent aquatic plants similar to a Rosgen type “D” channel. Boating restriction signs are recommended from the estuary upstream to the RXR.

Project #2: Angler’s have recently reported a harvest of walleye in this section of Welland River East in sping May- June season. This may mean that walleye from upstream stocking have dispersed downstream and are now congregating or staging in this section of the river or Niagara River walleye (Lake Erie Origin) are moving into this reach. Natural functions of upstream woody debris supply through the canal syphons are blocked, therefore, to promote staging functions a substantial amount of woody material needs to be added to this channelized section of river.

Project #3: Movement of a spawning migration of walleye through the Shipping Canal and Fourth Canal siphons is likely impaired, an enhanced spawning area downstream of the Shipping canal near the Railway crossing is recommended. Designs of spawning beds include the addition of mixed river rock (1 to 4 inch) diameter in piles below the GIP controlled daily flux elevations.

## 5.5.3 Welland River West

### River Riparian Zone Function

The Welland River West is the most impacted ARA in the Niagara River watershed and has departed from a channel that was defined by its riparian vegetation to one that is overly wide, sluggish, infilled and excessively turbid (Figure 91). The physical habitat in this section of the river is comparatively simple and homogenous, lacking in the typical ecological vegetation zones found along low gradient and fine sediment rivers (Rosgen type E6 or C6). The erosion of these zones means the river is too wide and shallow to dynamically transport its sediment load downstream. This state contributes to its sluggish nature, and high turbidity. Instream habitat, shrub and emergent marsh vegetation and structure are typically lacking in territorial markers, diversity of substrate, cover, emergent wetland, spawning and nursery areas (Figures 92 and 93). To fully understand the state of the river we recommend applying a level III assessment of river condition and departure (Rosgen 1996), which would result in a watercourse reach evaluation as it relates to stream stability, potential and function (Appendix B).

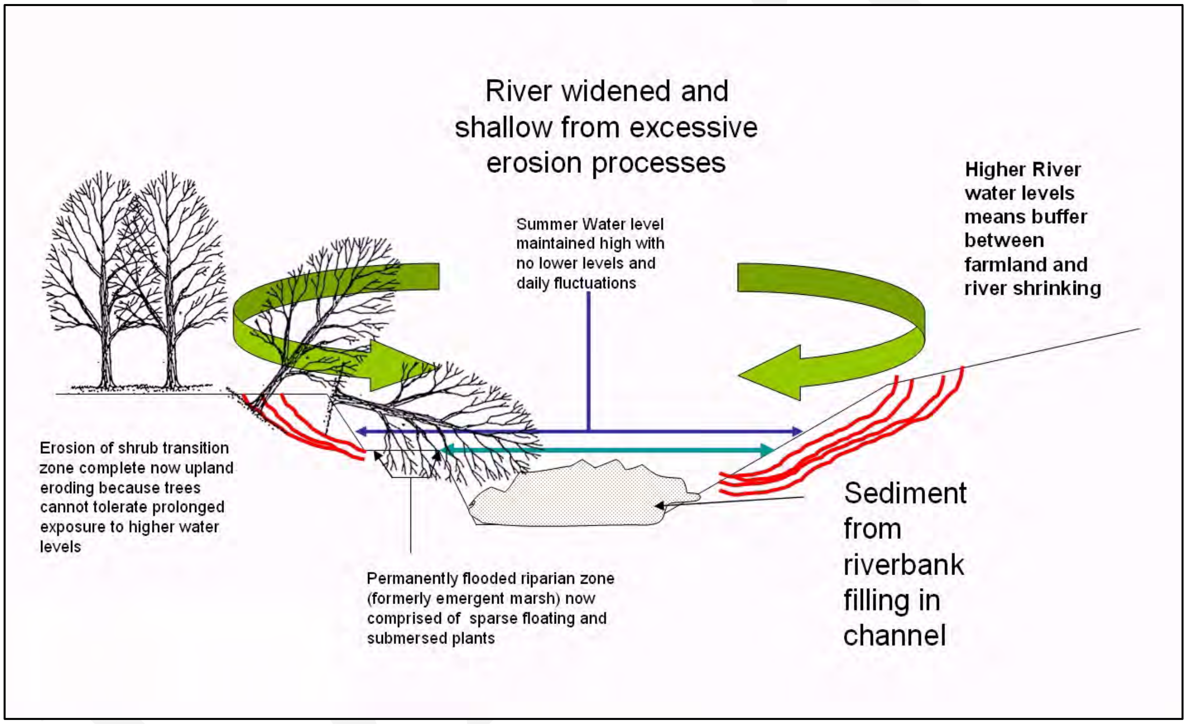
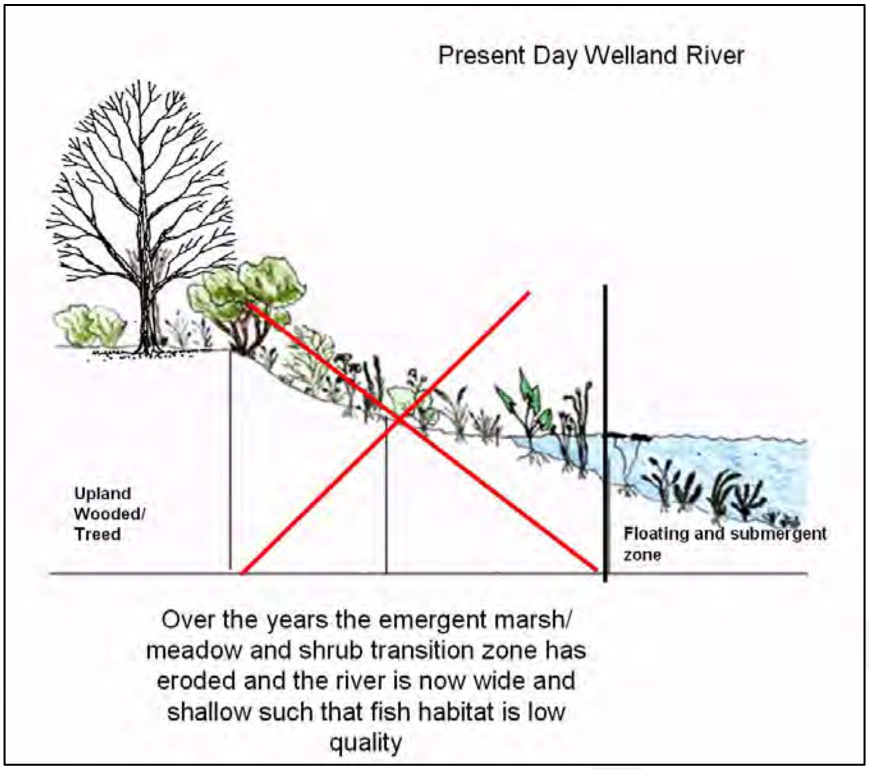


Figure 91 Ongoing Erosional processes at work in the Welland River West

## 5.5.4 Woody Debris Function

In addition to stream bank erosion, instream cover features are inhibited from naturally developing because this section of river is cut off from upstream woody debris sources. All woody material generated from the Binbrook Reservoir downstream is held up at the railway tressels located on Oswego Creek and on the Welland River near Port Davidson (Figure 94). Large woody debris is a very important attribute of fish habitat by providing structure for fish to hide and by providing the shoreline with natural resistance to erosional processes creating variable areas of sedimentation and erosion for aquatic plants to develop and sediments to settle (Figure 95). These functions are impaired in the Welland River West and because of the syphon structures this function is imparied in the Welland River Between the canals and Welland River East ARAs.



Over the years the emergent marsh/ meadow and shrub transition zone has eroded and the river is now wide and shallow such that fish habitat is low quality

Figure 92 Conceptual Drawing of Existing Riparian Conditions of the Welland River West

Figure 93 Welland River West examples of shoreline riparian condition

Figure 94 Oswego Creek Tressel (left) and Port Davidson Tressel (right) block large woody debris

**Figure 95 Example of woody debris promoting emergent wetland plant growth in Welland River West**

## Restoration Goal

The restoration goal of this river section is to recreate the lost ecological riparian zones (Figure 96). This result can be accomplished by narrowing the summer active channel width using a combination of resistive woody material and/or course material as a stable base, behind which germination plots of cattail or other emergent aquatic plants can be seeded (Figure 97). These structures provide side areas along the shallow shoreline with very low to zero flow where suspended solids can drop thus removing suspended sediment from the active channel. Nutrient assimilation processes will be improved in these backwater areas both by sedimentation and by adsorption onto the developed vegetation. Using the natural flow forces of the river, the smaller remaining active channel will have increased flow because of a reduced width-to-depth ratio. Increased flow will help to flush accumulated soft sediments on the narrowed channel bottom and ultimately expose the hard pan clay bottom or any existing coarser bed substrates. Outside meanders are targeted so increased flow force in the narrowed channel will hit a hardened edge and therefore not cause lateral movement of the channel. However, this kind of ‘side bar’ construction can occur in straight river sections or act to enhance point bar formations on inside meanders. Additional coarse material is recommended throughout. The addition of such material as spawning substrate for walleye has proven a successful technique in specifc areas of the river (MNR spring 2008 surveys) and should continue (Yagi, 2007).

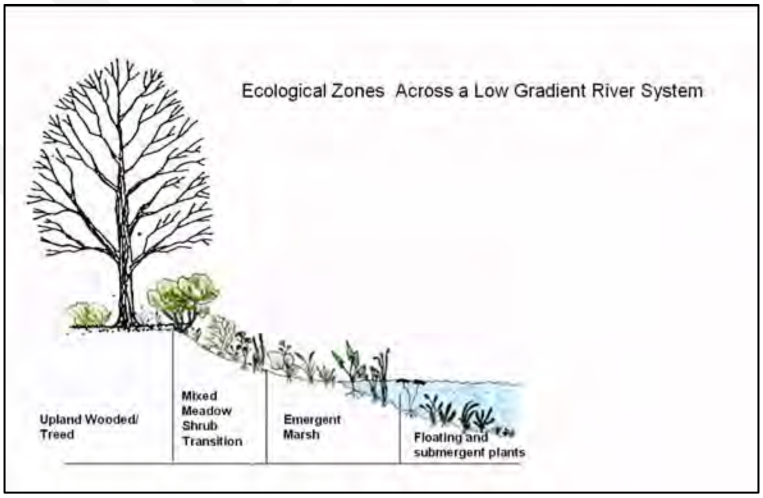


**Figure 96 Conceptual Riparian Ecological Zones - river bank goal for Welland River West**

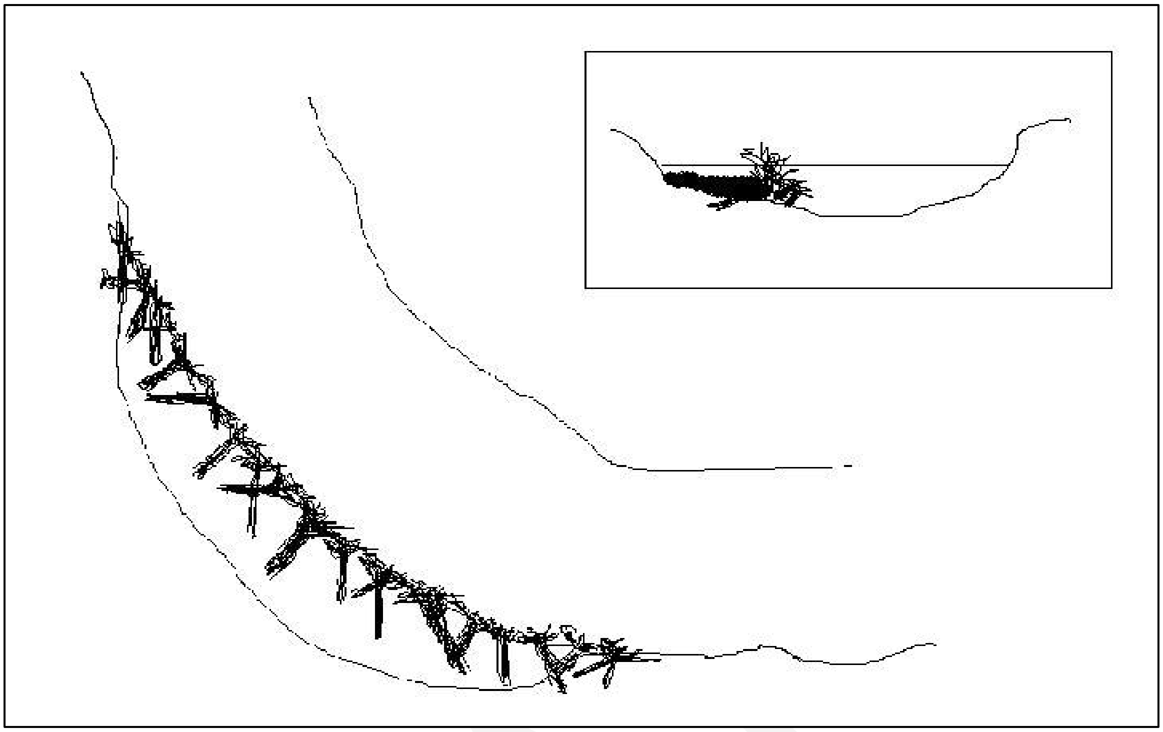


**Figure 97 Welland River Habitat Development Concept – plan view & inset of cross section**

## 5.5.5 Other Tributary Habitat Projects

### Tributaries with Permanent Flow

Flowing streams and seasonally flowing streams offer a diversity of habitat for the Niagara River fish community. Lithophillic (rock loving) assemblages of species are typically found in flowing streams whereas seasonally flowing streams attract spawning migrations for adult anadromous species and create excellent juvenile or nursery habitat when the flows recede forming permanent residual pool habitat. Other than the Welland River, there are a limited number of tributaries with permanent or augmented base flow. They are Frenchman's Creek, Ussher's Creek, Tea Creek, Lyon's Creek, Thompson Creek, Draper's Creek, Biederman Drain, Church Rd Tributary and Buckhorn Creek. Due to their rarity in the watershed, tributaries with permanent flow have received more restoration effort than intermittent tributaries which are often the target of drain maintenance activities regulated under the Drainage Act. Frenchmans Creek is the best documented example where habitat improvements within the tributary have demonstrable effects both within the tributary and within the Niagara River (Frenchman's Creek Rehab Plan, 1992). Other project sites include Lower Draper's Creek and Ussher's Creek through Legends Golf Course. In each of these systems there has been a shift in the species community to reflect better flowing stream conditions.

### Tributaries with Intermittent Flow

Most Niagara River watershed tributaries have only seasonal flow with remnant pool refugia and are therefore intermittent. Intermittent tributaries of the Niagara River watershed can appear to be of poor quality in summer due to the lack of flow. However, these tributaries play an important role as juvenile fish habitat, as well as contributing to overall habitat availability in a system that is generally limited by precipitation. Limited available water steers rehabilitation efforts to focus on capturing as much surface flow and precipitation as possible, and keeping that water on the landscape as long as possible. This is accomplished by increasing floodplain storage, wetland creation and maximizing channel shape diversity and canopy cover to slow down release and evaporation. These objectives can be accomplished by re-establishing riparian growth along as much of the length of each tributary as possible, including the higher reaches where tributaries may be perceived as dry drainages that function only to convey spring flow. Restorative work in Coyle Creek has also likely resulted in improvements to that system, but historic data is not available for comparison.

Some work has been done on intermittent tributaries to preserve, reclaim or extend the length and area of riparian areas. These efforts should continue. Where there may be no water source to tap, a well established riparian buffer can better entrap surface water, and decrease evaporation so that duration of surface water can be extended longer and possibly over a greater area. Several tributaries upstream of Port Davidson for example have only a short extent of riparian buffer near their downstream ends, and patches of riparian growth around deeper residual pools. Beyond these areas the tributaries are often incorporated into cropland. Some farmers indicated they desired a better defined channel across their fields and thus a program to re-establish riparian growth could benefit both the landowner and the resource.

Restoration plans should consider the desirable diversity achieved with a mix of substrate types. For example, a restoration plan would not want to convert organic peat soils to a rubble type habitat, but should be looking at wetland rehabilitation. Recent fish sampling results suggest that there may be active siltation occurring in Miller Creek and Black Creek and these creeks should be assessed as to the need for restoration efforts. Therefore individual tributary fish habitat restoration plans are recommended.

### Tributaries with Special Considerations

Lyons Creek East is a provincially significant wetland, critical habitat for the lake chubsucker a species at risk (COSEWIC 2008, endangered) and also has elevated contaminated sediment levels. Therefore a *Monitored Natural Recovery* was selected by the Niagara River RAP implementation team, as the best approach to manage the contaminated sediments. This approach allows for the ongoing natural rate of contaminated sediment burial to continue while a monitoring program is developed to periodically assess the natural recovery of the creek. Administrative controls are established to ensure that the sediments are not disturbed (i.e no dredging) and therefore prevent re-suspension of the contaminated sediment (NR RAP, 2008). Given that the lake chubsucker range in Niagara is now restricted to Lyon’s Creek east, special fisheries management considerations include a prohibition on predator stocking (walleye and northern pike) and a prohibition of activities that remove natural migration “barriers” (i.e.dredging or removal of beaver dams and woody debris jams).

## 5.6 MANAGED SPECIES RE-INTRODUCTIONS

Ideally, managed introductions (i.e stocking, relocations) are not necessary if there is a self sustaining population, suitable habitat quality, quantity and connectivity. When connectivity or habitat (quality or quantity) is suspect, stocking of a species intolerant of the poor attribute, and subsequent assessment of its presence, distribution and abundance after a period of time can explain if the poor attribute is still limiting that species. This technique was used as the basis for the managed re-introduction of walleye into the upper Welland River watershed. The first concern was whether water quality was sufficient to support walleye given the concerns raised with summer low oxygen and high temperatures. Walleye fingerlings were stocked annually from 1997 and onward. Local conservation clubs (Dunnville Hunters and Angler’s, Port Colborne and District Conservation Club and Fort Erie Conservation Club) using Grand River genetic material hatched from a bell jar hatchery, raised swim up fry to fingerling size in club ponds, then relased young walleye in July into the Welland River near Attercliff (above the Port Davidson weir). Follow up fisheries assessment in 2004 showed walleye were present in the fish community. Sampling in 2005 collected all expected age classes and found walleye present and in areas of better water quality and absent in areas of poor water quality. Overtime walleye dispersed downstream into all main stem areas of the Welland River. In the summer of 2007 stocking location was restricted to Welland River Between-the-Canals due to concerns with viral hemorhatic septicemia (VHS). However, that year, a young–of-the-year walleye was captured above the Port Davidson weir in the upper watershed suggesting walleye were naturally reproducing in that location. Therefore, during the assessment period we determined that there are areas with sufficient quality of habitat to support walleye during poor water quality periods over several years. We also found evidence of downstream dispersal, spring spawning aggregations in areas of coarser substrate (Yagi, 2006) and possibly successful reproduction (MNR unpublished data). A self sustaining population maybe possible but requires another few years of annual sampling following a curtailment of stocking.

Therefore, when limiting factors affecting dispersal remain, habitat restoration projects can be tested through the introduction of native species with higher tolerance limits. Presence of these species over time would indicate a successful project.  Some suggestions to consider are outlined in Table 50.

**Table 50 Suggested target species dispersal/introductions in tributaries**

| Species | Comments | Target Tributaries |
|---|---|---|
| brassy minnow (*Hybognathus hankinsoni)* | Occurs in creeks and brooks, but it often more abundant in the cool, dark acid waters of silt-bottomed bog ponds where it usually occurs in association with northern redbelly dace (*Phoximus eos*), finescale dace (*Chrosomus neogaeus*), fathead minnow (*Pimephales promelas*) and pearl dace (*Semotilus margarita*). Is intolerant of turbidity and low dissolved oxygen | Buckhorn Creek<br>Tea Creek<br>Lyons Creek |
| brook stickleback (*Culaea inconstans*) | Headwater wetland tributary dweller with temperature sensitivity. Presence/ abundance of this species would indicate groundwater system and moderate water quality. | Frenchmans Creek<br>Tea Creek<br>Lyons Creek |
| finescale dace (*Chrosomus neogaeus*) | Not found with surveys. Usually associated with Brook Stickleback (*Culaea inconstans*). Preferred habitat is groundwater fed, cool bog lakes, streams. | Buckhorn Creek, Drapers Creek<br>Coyle Creek<br>Tea Creek<br>Lyons Creek |
| grass pickerel (*Esox americanus vermiculatus*) Species at Risk | Introduce as a resident tributary top predator. A phytophillic species associated with wetland streams – those streams with abundant aquatic vegetation and clear water. Grass pickerel are able to survive in the small isolated pools. | Drapers Creek<br>Coyle Creek<br>Frenchmans Creek |
| blacknose dace (*Rhinichthys atratulus*) | Found in Frenchmans. This commonly occurring species in the Great Lakes basin is a tributary dweller of streams with moderate water quality. Its presence would indicate improved habitat quality and system connectivity. | Drapers Creek<br>Coyle Creek<br>Buckhorn Creek |
| creek chub (*Semotilus atromaculatus*) | Found only in the Niagara River, Frenchmans Creek, Drapers Creek, Coyle Creek, and Trinity Church and Kird Rd tributaries. A moderatley tolerant species found commonly in the Great Lakes basin. This species has a limited distribution and low abundance upstream of the Niagara River. It presence indicates, intermittent to flowing creeks with moderate water quality and moderate temperatures and system connectivity. | All tributaries |

| Species | Comments | Target Tributaries |
|---|---|---|
| central stoneroller (*Campostoma anomalum*) | Historically found in Frenchmans Creek. The literature indicates the Central Stoneroller habitat includes moderate to high gradient streams with sandy to gravelly substrate, preferring riffles areas where riffles and pools alternate in rapid succession, however the species is very tolerant and can survive in almost any stream with a food supply (Ohio State University web site). | Drapers Creek<br>Coyle Creek<br>re-establish in Frenchmans Creek |
| fantail darter (*Etheostoma flabellare*) | Historically found in Usshers. Recent in 12mile Creek. This species requires small, shallow-water, gravel and boulder bottom streams (<18") for spawning and deeper downstream waters for overwintering. Slow to moderate currents seem to be preferred. Less sensitive to moderate turbidity and silting than rainbow darter. | Niagara River tribs, Coyle Creek<br>Drapers Creek<br>(Not suitable substrate in Buckhorn). |
| sucker species<br>-white sucker (*Catastomus commersoni*)<br>-shorthead redhorse (*Moxostoma macrolepidotum*) | Both commonly found in the Great Lakes basin they should have a wider distribution and higher abundance in the watershed. Increase in abundance and distribution would indicate improved connectivity within the AOC. | All tributaries and main branches |
| greater redhorse (*Moxostoma valenciennesi*) | Presence would indicate improvements in water quality namely turbidity and sedimentation. | All Upper Niagara Tributaries and Niagara River shoreline areas, main stem Welland River. |
| wallleye (*Stizostedion vitreum*) | Continued stocking of summer fingerlings (MNR-CFWIP project) until evidence of self sustaining population. MNR stocking of fall fingerlings in VHS control areas to begin fall 2008 for a minimum of five years. Summer distribution and abundance will increase with improved water quality. This species is an excellent indicator of improved water quality and substrate diversity. Spring sampling with mark /recapture (tagging) upstream and downstream of canal syphons would help determine successful mitigation of migration barrier. | All main branches |
| largemouth bass (*Micropterus salmoides*) | This species will benefit from improved habitat quality and shoreline habitat projects in Welland River West. | All main branches and large tributaries |
| muskellunge (*Esox masquinongy*) | Native to the Niagara River system with large home ranges, it is also intolerant of turbidity and high temperatures. Its presence would indicate improved connectivity in suitable habitat areas. Evidence of declining YOY abundances in traditional Upper Niagara wed beds needs further monitoring. | All main branches and large tributaries |
| Bigmouth Buffalo (*Ictiobus cyprinellus*) | Found predominantly in Welland River West its presence upstream of Port Davidson indicates improved connectivity through the Port Davidson weir structure. | Welland River Upstream of Port Davidson |

# 6 MANAGEMENT RECOMMENDATIONS

## 6.1 PRIORITIZE ECOLOGICAL BASED RESTORATION PROJECTS

1. To stop operational controls of summer daily water levels (IJC treaty)
2. Mitigate water flow controls at 3 locations; Triangle Island, Old Canal and Binbrook Reservoir operations
3. Mitigate connectivity controllers at the Triangle Island and Old Canal siphons
4. Complete instream habitat restoration within Upper Niagara River Tributaries, Welland River East and Port Robinson channel, Welland River West
5. Apply a level III fluvial geomorphic assessment of river condition and departure (Rosgen 1996) for each reach of the Welland River West as it relates to stream stability, potential and function
6. Completed tributary specific restoration plans
7. Managed species introductions to assess limiting factors

## 6.2 MONITORING

1. Continued assessment of the fish community is vital to understand how restoration projects are affecting the watershed. And to test the effectiveness of shoreline habitat restoration projects use standardized monitoring of characteristics such as plant community, flow, width, depth, water level and substrate.

2. Fish assessment monitoring is necessary within the project area as well as within control areas and the main stem river sections in order to understand the system implications.

3. A further look into past fish barrier removal projects is warranted to access effectivness of those projects. Complete mark/recapture tagging surveys and/or radio telemetry of spring migrants to assess effectiveness of current siphon structures and any future modifications to siphon structures.

4. Spring surveys are necessary to access the effectiveness of walleye management projects and fish barrier projects. Assess Restoration Projects

## 6.3 FILL DATA GAPS

1. Some base data remains uncollected for Wilson Creek above the Port Davidson weir and the Upper Niagara River needs further baseline data as only a limited area was sampled.

2. Determine a water budget goal for the Welland River upstream of the Old Canal that provides an appropriate amount of base flow augmentation to the Welland River during summer and winter low flow seasons such that downstream flows are evident during these seasons. Include real time base flow moniotoring of all permanent and artificial sources of base flow. Target tributaries for base flow monitoring are:

   Welland River headwaters
   Buckhorn Creek
   Church Road Tributary

Binbrook reservoir
Welland River Upstream of Port Davidson
Oswego Creek
Coyle Creek
Drapers Creek

3. Complete spring migratory fish community sampling in each main stem portion of the Niagara and Welland River ARAs to identify spring spawning concentrations of suckers, northern pike, walleye and cyprinids and their relative abundances.

## 6.4 MEET SAR RECOVERY NEEDS

Determine limting factors for SAR fish species native to the Niagara River Fish Community, including grass pickerel, American eel, lake sturgeon and lake chubsucker to assit in the recovery effort for these species.

## 6.5 REGIONAL REFERENCE SITES

Determine appropriate regional reference sites to assess fish community indices (Index of Biotic Integrity-IBI) for sport fish management, system connectivity, habitat quality, species richness and abundance.

## 6.6 UPDATE FISHERIES MANAGEMENT GOALS

With the establishment of walleye in the fish community and the increase in available information, Sport Fish Management Goals for AOC should be updated. Creel surveys will help determine species targeted, harvested, effort and client preferences.

## 6.7 INFORM STAKEHOLDERS

1. Update the main fish community report as new information becomes available.
2. Meet with stakeholders
3. Prepare a “State of the River” brochure.

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# 8 GLOSSARY OF ABBREVIATIONS & TERMS

ARA – Aquatic Resource Area – defined for the Niagara River watershed based on natural and anthropogenic boundaries

CPUE – catch per unit effort. As an example, boat electrofishing results are standardized to a catch per unit effort of 1000 electrofishing seconds. See Methods for more details.

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

GIP – Grassy Island Pool – location in the Niagara River just upstream of the falls where water is backed up during the night to provide a head for day time water users.

Lithophilic – refers to species that are found in association with clearer water and gravel to rubble bottoms

NYDEC – New York Department of Environmental Conservation

OPG – Ontario Power Generation – an Ontario-based electricity company

Old Welland Canal – another name for the 4th Welland Canal, constructed in 1932.

Phytophilic – refers to species that are "plant-loving" and are found in association with aquatic vegetation, or require aquatic vegetation for some part of their life history

Rheotactic – refers to some species that orientate their bodies in the direction of flow or move in response to flow cues. Their presence in upstream locations would indicate a positive rheotactic response.

ROM – Royal Ontario Museum

Thermotactic – refers to species that respond behaviorally to changes or differences in temperature.

VHS - viral hemorrhagic septicemia – first detected in Canadian freshwater in Lake Ontario in 2005

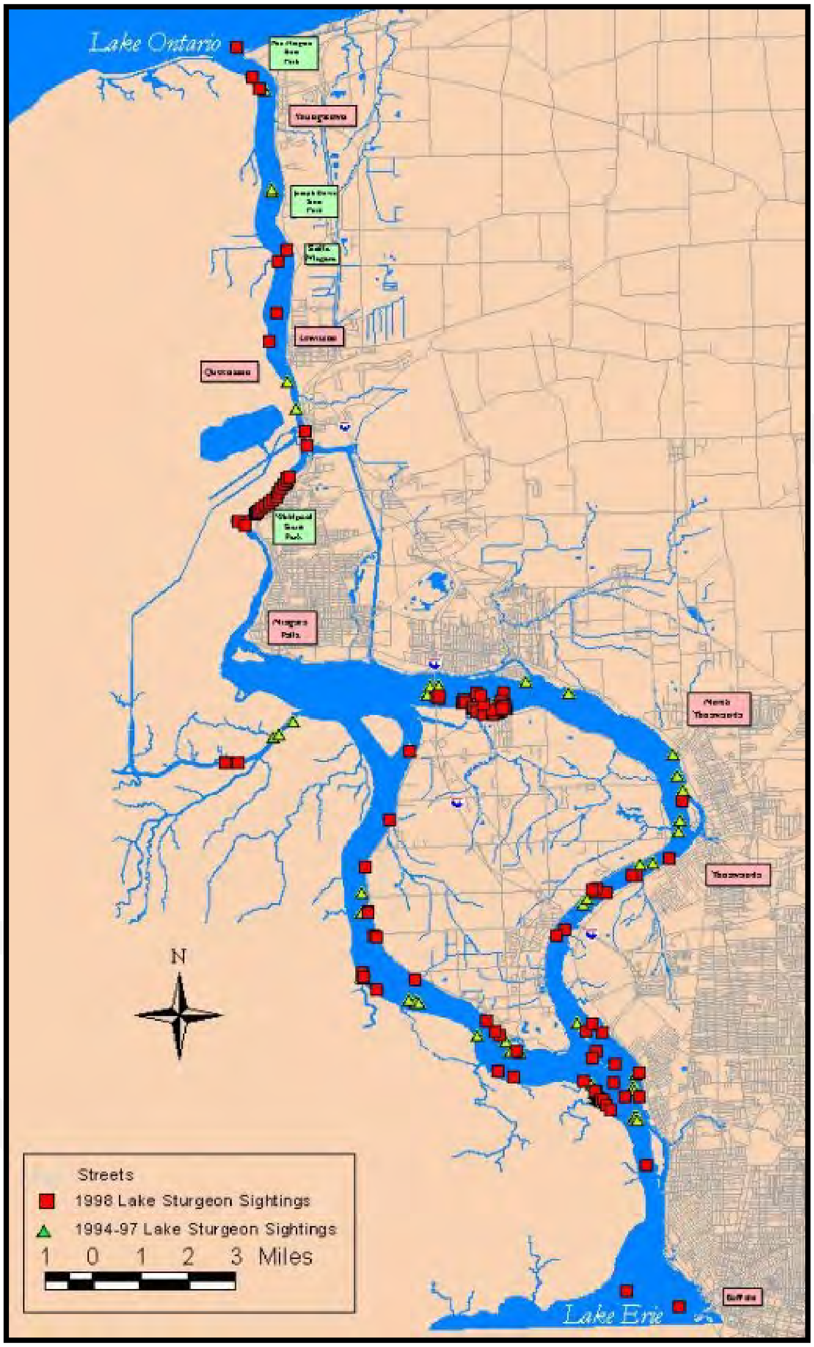
WRW – Welland River West aquatic resource area

WRE – Welland River East aquatic resource area

YOY – Young-of-the-Year fish – for this study, typically young of the year of larger species are defined as ≤100mm Total Length

# APPENDIX A

## LAKE STURGEON SITINGS ON THE NIAGARA RIVER



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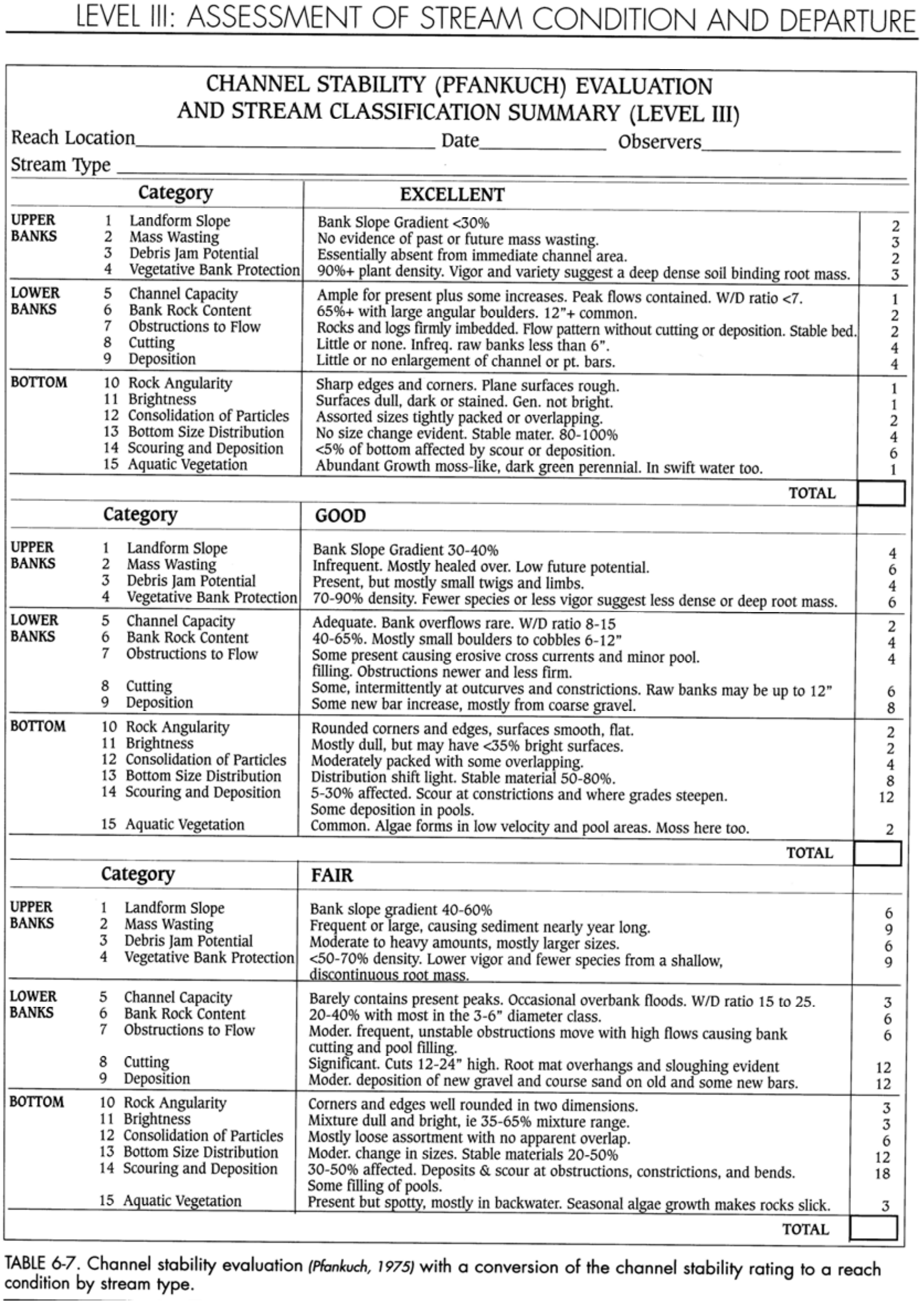
# APPENDIX B

## ROSGEN ASSESSMENT OF STREAM CONDITION AND DEPARTURE



LEVEL III: ASSESSMENT OF STREAM CONDITION AND DEPARTURE

### CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

Reach Location________________ Date________ Observers____________

Stream Type ________________________

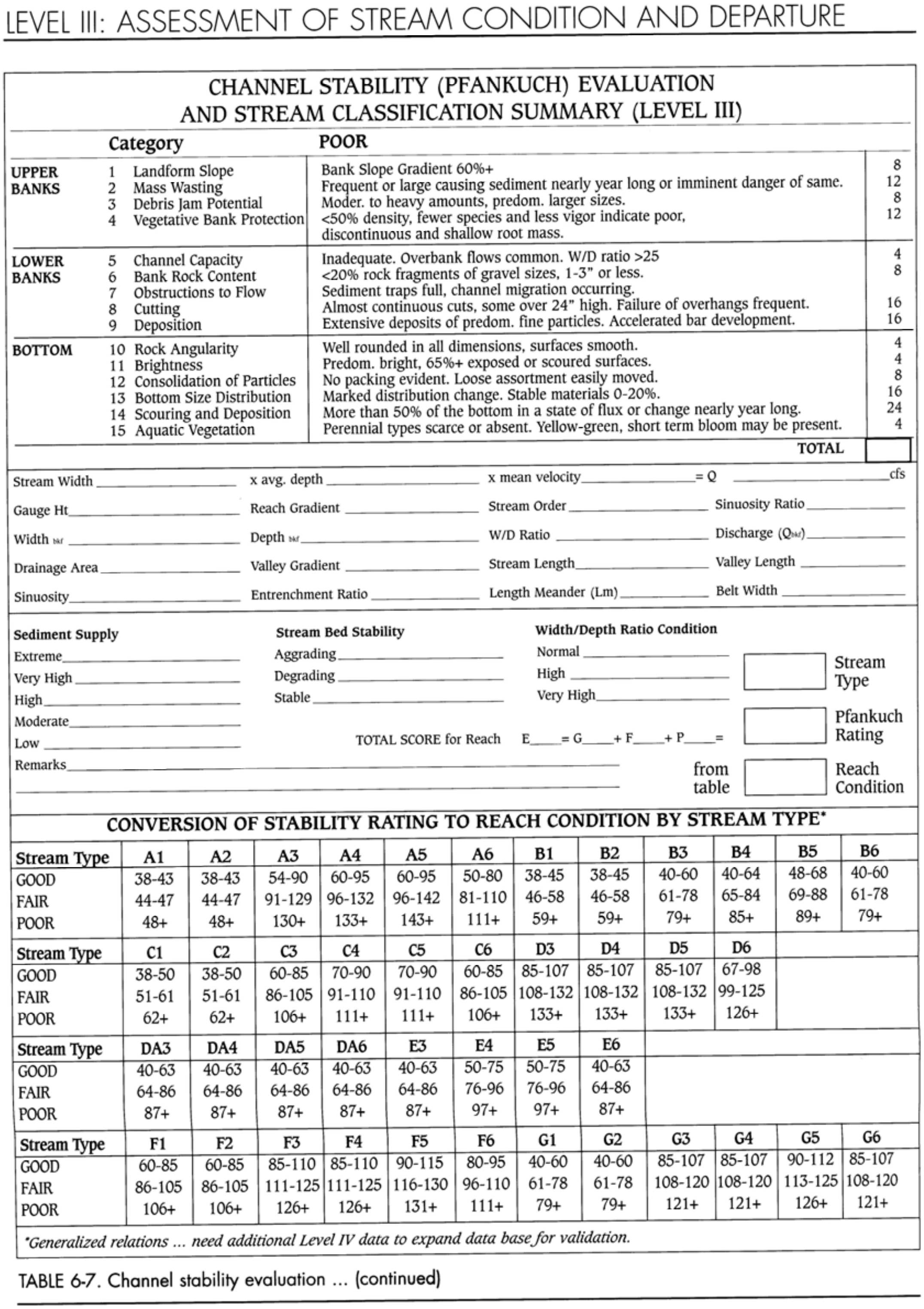
| | | Category | EXCELLENT | |
|---|---|---|---|---|
| **UPPER BANKS** | 1 | Landform Slope | Bank Slope Gradient <30% | 2 |
| | 2 | Mass Wasting | No evidence of past or future mass wasting. | 3 |
| | 3 | Debris Jam Potential | Essentially absent from immediate channel area. | 2 |
| | 4 | Vegetative Bank Protection | 90%+ plant density. Vigor and variety suggest a deep dense soil binding root mass. | 3 |
| **LOWER BANKS** | 5 | Channel Capacity | Ample for present plus some increases. Peak flows contained. W/D ratio <7. | 1 |
| | 6 | Bank Rock Content | 65%+ with large angular boulders. 12"+ common. | 2 |
| | 7 | Obstructions to Flow | Rocks and logs firmly imbedded. Flow pattern without cutting or deposition. Stable bed. | 2 |
| | 8 | Cutting | Little or none. Infreq. raw banks less than 6". | 4 |
| | 9 | Deposition | Little or no enlargement of channel or pt. bars. | 4 |
| **BOTTOM** | 10 | Rock Angularity | Sharp edges and corners. Plane surfaces rough. | 1 |
| | 11 | Brightness | Surfaces dull, dark or stained. Gen. not bright. | 1 |
| | 12 | Consolidation of Particles | Assorted sizes tightly packed or overlapping. | 2 |
| | 13 | Bottom Size Distribution | No size change evident. Stable mater. 80-100% | 4 |
| | 14 | Scouring and Deposition | <5% of bottom affected by scour or deposition. | 6 |
| | 15 | Aquatic Vegetation | Abundant Growth moss-like, dark green perennial. In swift water too. | 1 |
| | | | **TOTAL** | ☐ |

| | | Category | GOOD | |
|---|---|---|---|---|
| **UPPER BANKS** | 1 | Landform Slope | Bank Slope Gradient 30-40% | 4 |
| | 2 | Mass Wasting | Infrequent. Mostly healed over. Low future potential. | 6 |
| | 3 | Debris Jam Potential | Present, but mostly small twigs and limbs. | 4 |
| | 4 | Vegetative Bank Protection | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass. | 6 |
| **LOWER BANKS** | 5 | Channel Capacity | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 |
| | 6 | Bank Rock Content | 40-65%. Mostly small boulders to cobbles 6-12" | 4 |
| | 7 | Obstructions to Flow | Some present causing erosive cross currents and minor pool. filling. Obstructions newer and less firm. | 4 |
| | 8 | Cutting | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12" | 6 |
| | 9 | Deposition | Some new bar increase, mostly from coarse gravel. | 8 |
| **BOTTOM** | 10 | Rock Angularity | Rounded corners and edges, surfaces smooth, flat. | 2 |
| | 11 | Brightness | Mostly dull, but may have <35% bright surfaces. | 2 |
| | 12 | Consolidation of Particles | Moderately packed with some overlapping. | 4 |
| | 13 | Bottom Size Distribution | Distribution shift light. Stable material 50-80%. | 8 |
| | 14 | Scouring and Deposition | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. | 12 |
| | 15 | Aquatic Vegetation | Common. Algae forms in low velocity and pool areas. Moss here too. | 2 |
| | | | **TOTAL** | ☐ |

| | | Category | FAIR | |
|---|---|---|---|---|
| **UPPER BANKS** | 1 | Landform Slope | Bank slope gradient 40-60% | 6 |
| | 2 | Mass Wasting | Frequent or large, causing sediment nearly year long. | 9 |
| | 3 | Debris Jam Potential | Moderate to heavy amounts, mostly larger sizes. | 6 |
| | 4 | Vegetative Bank Protection | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass. | 9 |
| **LOWER BANKS** | 5 | Channel Capacity | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25. | 3 |
| | 6 | Bank Rock Content | 20-40% with most in the 3-6" diameter class. | 6 |
| | 7 | Obstructions to Flow | Moder. frequent, unstable obstructions move with high flows causing bank cutting and pool filling. | 6 |
| | 8 | Cutting | Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident | 12 |
| | 9 | Deposition | Moder. deposition of new gravel and course sand on old and some new bars. | 12 |
| **BOTTOM** | 10 | Rock Angularity | Corners and edges well rounded in two dimensions. | 3 |
| | 11 | Brightness | Mixture dull and bright, ie 35-65% mixture range. | 3 |
| | 12 | Consolidation of Particles | Mostly loose assortment with no apparent overlap. | 6 |
| | 13 | Bottom Size Distribution | Moder. change in sizes. Stable materials 20-50% | 12 |
| | 14 | Scouring and Deposition | 30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools. | 18 |
| | 15 | Aquatic Vegetation | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick. | 3 |
| | | | **TOTAL** | ☐ |

TABLE 6-7. Channel stability evaluation *(Pfankuch, 1975)* with a conversion of the channel stability rating to a reach condition by stream type.

# ROSGEN ASSESSMENT OF STREAM CONDITION AND DEPARTURE cont'd



## LEVEL III: ASSESSMENT OF STREAM CONDITION AND DEPARTURE

### CHANNEL STABILITY (PFANKUCH) EVALUATION AND STREAM CLASSIFICATION SUMMARY (LEVEL III)

| | Category | POOR | |
|---|---|---|---|
| **UPPER BANKS** | 1 Landform Slope | Bank Slope Gradient 60%+ | 8 |
| | 2 Mass Wasting | Frequent or large causing sediment nearly year long or imminent danger of same. | 12 |
| | 3 Debris Jam Potential | Moder. to heavy amounts, predom. larger sizes. | 8 |
| | 4 Vegetative Bank Protection | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass. | 12 |
| **LOWER BANKS** | 5 Channel Capacity | Inadequate. Overbank flows common. W/D ratio >25 | 4 |
| | 6 Bank Rock Content | <20% rock fragments of gravel sizes, 1-3" or less. | 8 |
| | 7 Obstructions to Flow | Sediment traps full, channel migration occurring. | |
| | 8 Cutting | Almost continuous cuts, some over 24" high. Failure of overhangs frequent. | 16 |
| | 9 Deposition | Extensive deposits of predom. fine particles. Accelerated bar development. | 16 |
| **BOTTOM** | 10 Rock Angularity | Well rounded in all dimensions, surfaces smooth. | 4 |
| | 11 Brightness | Predom. bright, 65%+ exposed or scoured surfaces. | 4 |
| | 12 Consolidation of Particles | No packing evident. Loose assortment easily moved. | 8 |
| | 13 Bottom Size Distribution | Marked distribution change. Stable materials 0-20%. | 16 |
| | 14 Scouring and Deposition | More than 50% of the bottom in a state of flux or change nearly year long. | 24 |
| | 15 Aquatic Vegetation | Perennial types scarce or absent. Yellow-green, short term bloom may be present. | 4 |
| | | **TOTAL** | ☐ |

Stream Width ________ x avg. depth ________ x mean velocity________ = Q ________cfs

Gauge Ht________ Reach Gradient ________ Stream Order ________ Sinuosity Ratio ________

Width $_{bkf}$ ________ Depth $_{bkf}$ ________ W/D Ratio ________ Discharge ($Q_{bkf}$) ________

Drainage Area ________ Valley Gradient ________ Stream Length________ Valley Length ________

Sinuosity________ Entrenchment Ratio ________ Length Meander (Lm) ________ Belt Width ________

**Sediment Supply**

Extreme________

Very High ________

High________

Moderate________

Low ________

**Stream Bed Stability**

Aggrading________

Degrading ________

Stable ________

**Width/Depth Ratio Condition**

Normal ________

High ________

Very High________

☐ Stream Type

TOTAL SCORE for Reach E____ = G____ + F____ + P____ =

☐ Pfankuch Rating

Remarks________________________________

from table ☐ Reach Condition

### CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE*

| Stream Type | A1 | A2 | A3 | A4 | A5 | A6 | B1 | B2 | B3 | B4 | B5 | B6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GOOD | 38-43 | 38-43 | 54-90 | 60-95 | 60-95 | 50-80 | 38-45 | 38-45 | 40-60 | 40-64 | 48-68 | 40-60 |
| FAIR | 44-47 | 44-47 | 91-129 | 96-132 | 96-142 | 81-110 | 46-58 | 46-58 | 61-78 | 65-84 | 69-88 | 61-78 |
| POOR | 48+ | 48+ | 130+ | 133+ | 143+ | 111+ | 59+ | 59+ | 79+ | 85+ | 89+ | 79+ |
| **Stream Type** | **C1** | **C2** | **C3** | **C4** | **C5** | **C6** | **D3** | **D4** | **D5** | **D6** | | |
| GOOD | 38-50 | 38-50 | 60-85 | 70-90 | 70-90 | 60-85 | 85-107 | 85-107 | 85-107 | 67-98 | | |
| FAIR | 51-61 | 51-61 | 86-105 | 91-110 | 91-110 | 86-105 | 108-132 | 108-132 | 108-132 | 99-125 | | |
| POOR | 62+ | 62+ | 106+ | 111+ | 111+ | 106+ | 133+ | 133+ | 133+ | 126+ | | |
| **Stream Type** | **DA3** | **DA4** | **DA5** | **DA6** | **E3** | **E4** | **E5** | **E6** | | | | |
| GOOD | 40-63 | 40-63 | 40-63 | 40-63 | 40-63 | 50-75 | 50-75 | 40-63 | | | | |
| FAIR | 64-86 | 64-86 | 64-86 | 64-86 | 64-86 | 76-96 | 76-96 | 64-86 | | | | |
| POOR | 87+ | 87+ | 87+ | 87+ | 87+ | 97+ | 97+ | 87+ | | | | |
| **Stream Type** | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **G1** | **G2** | **G3** | **G4** | **G5** | **G6** |
| GOOD | 60-85 | 60-85 | 85-110 | 85-110 | 90-115 | 80-95 | 40-60 | 40-60 | 85-107 | 85-107 | 90-112 | 85-107 |
| FAIR | 86-105 | 86-105 | 111-125 | 111-125 | 116-130 | 96-110 | 61-78 | 61-78 | 108-120 | 108-120 | 113-125 | 108-120 |
| POOR | 106+ | 106+ | 126+ | 126+ | 131+ | 111+ | 79+ | 79+ | 121+ | 121+ | 126+ | 121+ |

**Generalized relations ... need additional Level IV data to expand data base for validation.*

TABLE 6-7. Channel stability evaluation ... (continued)

# APPENDIX C

## MNR Historic Fish Surveys of the Upper and LowerNiagara River

# Historical Fish Data Sampled in the Lower Niagara River

| | | Year and Method X = Present | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **1974 Trap & Seine Nets** | **1980 Gill Net** | **1986 Electro fish** | **1987 Electro fish & Hoopnet** | **1989 Trawl** | **1991 Trawl** | **1992 Trawl** | **1993 Trawl** | **199x Trap net** |
| Sea Lamprey | *Petromyzon marinus* | | | | | | 2 | 2 | 1 | |
| Alewife | *Alosa pseudoharengus* | 84 | | | | 1183 | | 90 | 112 | |
| Gizzard Shad | *Dorosoma cepedianum* | | | 3 | | | | | | |
| Lake Trout | *Salvelinus namaycush* | | | 2 | | 204 | 17 | 87 | 67 | |
| Lake Herring | *Coregonus artedi* | | | | | | | 3 | | |
| Rainbow Smelt | *Osmerus mordax* | 1 | | | | 59,375 | 23,068 | 52,709 | 46,744 | |
| Northern Pike | *Esox lucius* | | | | | | | | | X |
| Muskellunge | *Esox masquinongy* | | 1 | | | | | | | |
| White sucker | *Catostomus commersoni* | 5 | 7 | 64 | 26 | | | | | X |
| Redhorse sp. | *Moxostoma sp.* | 7 | 2 | 10 | | | | | | X |
| Common Carp | *Cyprinus carpio* | 7 | 4 | 2 | | | | | | |
| Goldfish | *Carassius auratus* | 3 | | | | | | | | |
| Carp-Goldfish | | 3 | | 20 | | | | | | |
| Emerald Shiner | *Notropis atherinoides* | 112 | | | | | | | | |
| Common Shiner | *Luxilus cornutus* | 3 | | | | | | | | |
| Spottail Shiner | *Notropis hudsonius* | 70 | | 17 | | | | | | |
| Mimic Shiner | *Notropis volucellus* | 1 | | | | | | | | |
| Bluntnose Minnow | *Pimephales notatus* | 30 | | | | | | | | |
| Longnose Dace | *Rhinichthys cataractae* | 5 | | | | | | | | |
| Brown Bullhead | *Ameiurus nebulosus* | | | | 76 | | | | | X |
| Channel Catfish | *Ictalurus punctatus* | | | | | | | | | X |
| American Eel | *Anguilla rostrata* | | | 2 | | | | | | X |
| Three-spined Stickleback | *Gasterostius aculeatus* | 11 | | | | | | 1 | | |
| Trout-perch | *Percopsis omiscomaycus* | | | | | 10 | 2 | | 12 | |
| White Perch | *Morone americana* | 1 | 20 | 129 | | | | | | X |
| White Bass | *Morone chyrsops* | 5 | | | | | | | | X |
| Rock Bass | *Ambloplites rupestris* | 13 | 22 | 28 | 24 | | | | | X |
| Pumpkinseed | *Lepomis gibbosus* | 19 | | | | | | | | |
| Bluegill | *Lepomis macrochirus* | 4 | | | | | | | | |
| Largemouth Bass | *Micropterus salmoides* | 2 | | 1 | 3 | | | | | |
| Smallmouth Bass | *Micropterus dolomieui* | 2 | 3 | 25 | 8 | | 2 | | 3 | |
| Black Crappie | *Pomoxis nigromaculatus* | 2 | | | 1 | | | | | |
| Yellow Perch | *Perca flavescens* | 8 | 98 | 67 | 26 | | | | | X |
| Walleye | *Stizostedion vitreum* | | 1 | 8 | | | | | | |
| Rainbow Darter | *Etheostoma caeruleum* | 22 | | | | | | | | |
| Johnny Darter | *Etheostoma nigrum* | 4 | | | | | 1 | | | |
| Logperch | *Percina caprodes* | 5 | | | | | | | | |
| Freshwater Drum | *Aplodinotus grunniens* | | | 3 | | | | | | X |
| Mottled Sculpin | *Cotus bairdi* | 2 | | | | | | | | |
| Slimy Sculpin | *Cottus cognatus* | | | | | 201 | 111 | 199 | 2 | |

## Historical Fish Data Sampled in the Upper Niagara River

| | | Year and Method | | | | | |
|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **1964 Seine Net** | **1972 Electrofish & Seine Net** | **1972 Trap net** | **1974 Seine Net** | **1980 Gill net** | **1982 Gill net** |
| Longnose gar | *Lepisosteus osseus* | | X | X | | | |
| Bowfin | *Amia calva* | | X | X | | | |
| Alewife | *Alosa pseudoharengus* | | | | 19 | | |
| Rainbow Smelt | *Osmerus mordax* | | | | 3 | | |
| Northern Pike | *Esox lucius* | 2 | X | 8 | | | |
| Muskellunge | *Esox masquinongy* | 4 | | 4 | | | |
| Central Mudminnow | *Umbra limi* | | | | 1 | | |
| Quillback Carpsucker | *Carpiodes cyprinus* | X | | X | 1 | | |
| White sucker | *Catostomus commersoni* | X | X | X | 78 | 25 | |
| Northern Hog Sucker | *Hypentelium nigricans* | X | | X | 13 | | 1 |
| Redhorse sp. | *Moxostoma sp.* | | X | X | 8 | 1 | 1 |
| Common Carp | *Cyprinus carpio* | X | X | X | 5 | | |
| Goldfish | *Carassius auratus* | | X | X | 1 | | |
| Carp-Goldfish | | | | | 24 | | |
| Golden Shiner | *Notemigonus crysoleucas* | X | X | X | 8 | | |
| Emerald Shiner | *Notropis atherinoides* | X | | X | 116 | | |
| Common Shiner | *Luxilus cornutus* | X | | X | 5 | 2 | |
| Blacknose Shiner | *Notropis heterolepis* | X | | X | 11 | | |
| Spottail Shiner | *Notropis hudsonius* | X | X | X | 49 | 1 | |
| Bluntnose Minnow | *Pimephales notatus* | | X | X | 34 | | |
| Longnose Dace | *Rhinichthys cataractae* | | | | 9 | | |
| Creek Chub | *Semotilus atromaculatus* | | | | | | 2 |
| Brown Bullhead | *Ameiurus nebulosus* | | | X | 3 | 6 | |
| Stonecat | *Noturus flavus* | | | | | 5 | 1 |
| Banded Killifish | *Fundulus diaphanus* | X | X | X | 67 | | |
| Trout-perch | *Percopsis omiscomaycus* | | | | | 1 | |
| White Bass | *Morone chyrsops* | X | | X | | | |
| Rock Bass | *Ambloplites rupestris* | X | X | X | 7 | 25 | 2 |
| Pumpkinseed | *Lepomis gibbosus* | X | X | X | 1 | 3 | |
| Bluegill | *Lepomis macrochirus* | X | X | X | | | |
| Largemouth Bass | *Micropterus salmoides* | X | X | X | X | | |
| Smallmouth Bass | *Micropterus dolomieui* | X | X | X | 18 | 10 | 1 |
| Black Crappie | *Pomoxis nigromaculatus* | X | | X | 9 | | |
| Yellow Perch | *Perca flavescens* | X | X | X | 10 | 37 | |
| Rainbow Darter | *Etheostoma caeruleum* | X | | X | 15 | | |
| Iowa Darter | *Etheostoma exile* | X | | X | | | |
| Johnny Darter | *Etheostoma nigrum* | X | | X | 16 | | |
| Darter sp. | *Etheostoma sp.* | | | | 2 | | |
| Brook Silverside | *Labidesthes sicculus* | | X | X | | | |
| Mottled Sculpin | *Cotus bairdi* | | | | X | | |

Historical Fish Data Sampled in the Upper Niagara River (cont.)

| | | **Year and Method** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **1974 Gill net at Ussher's Creek** | **1974 Seine net at Ussher's Creek** | **1974 Seine net at Boyer's Creek** | **1974 Seine net at Black Creek** | **1974 Seine net at Miller Creek** | **1974 Seine net at Frenchman's Creek** | **1982 Seine net at Ussher's Creek** | **1987 Electrofish and Hoop net at Black Creek** |
| Alewife | *Alosa pseudoharengus* | | | 2 | | 159 | 2 | | |
| Muskellunge | *Esox masquinongy* | 1 | | | | | | | |
| Central Mudminnow | *Umbra limi* | | | | | | | 3 | |
| Quillback Carpsucker | *Carpiodes cyprinus* | | | | | | | 1 | |
| White sucker | *Catostomus commersoni* | | 13 | 2 | 9 | | 1 | 3 | 5 |
| Northern Hog Sucker | *Hypentelium nigricans* | 1 | 9 | | 5 | | | | |
| Greater Redhorse | *Moxostoma valenciennesi* | | | | | 4 | | | |
| Redhorse sp. | *Moxostoma sp.* | | 21 | 44 | | | | | |
| Common Carp | *Cyprinus carpio* | 1 | | | | | | | |
| Goldfish | *Carassius auratus* | | 2 | | | | | | |
| Carp-Goldfish | | | | 3 | 3 | | | | |
| Hornyhead Chub | *Nocomis biguttatus* | 1 | 1 | | | 2 | | | |
| Emerald Shiner | *Notropis atherinoides* | | 35 | 2 | | 130 | 34 | | |
| Common Shiner | *Luxilus cornutus* | 3 | 3 | | | 1 | | | |
| Spottail Shiner | *Notropis hudsonius* | | 42 | 2 | | 5 | | | |
| Bluntnose Minnow | *Pimephales notatus* | | 15 | 18 | 7 | 18 | | | |
| Longnose Dace | *Rhinichthys cataractae* | | 12 | | 20 | 2 | | | |
| Brown Bullhead | *Ameiurus nebulosus* | 1 | | | | | | | 215 |
| Three-spined Stickleback | *Gasterostius aculeatus* | | 1 | | | | | | |
| Rock Bass | *Ambloplites rupestris* | 6 | 5 | 3 | | 5 | | | 8 |
| Pumpkinseed | *Lepomis gibbosus* | | 1 | 1 | 1 | | | | |
| Bluegill | *Lepomis macrochirus* | | | | | | | 3 | |
| Largemouth Bass | *Micropterus salmoides* | | | 3 | | 1 | | | 4 |
| Smallmouth Bass | *Micropterus dolomieui* | | | | | 4 | | | |
| White Crappie | *Pomoxis annularis* | | | | 1 | | | | |
| Black Crappie | *Pomoxis nigromaculatus* | | | 13 | | 3 | | | 20 |
| Yellow Perch | *Perca flavescens* | | | 5 | 5 | 1 | 1 | 1 | 19 |
| Rainbow Darter | *Etheostoma caeruleum* | | 27 | 3 | 1 | | | | |
| Johnny Darter | *Etheostoma nigrum* | | 15 | | 2 | 1 | | | |
| Mottled Sculpin | *Cotus bairdi* | | 4 | 1 | 1 | 2 | 1 | | |