Cotyledon
Environmental Consulting

Joanne Savage, Mayor
Denis Senecal, Councilor Ward 8
Township of West Nipissing
Regarding: Nature Trail Bridge Re-construction Project
Via email March 20, 2021

I am writing on behalf of the Wolseley Bay stakeholders regarding the Nature Trail bridge re-construction project.

It is our understanding that this project is proceeding under a Municipal Class Environmental Assessment (MCEA) and the Township of West Nipissing is the proponent. Because the project has the potential to impact six tourist resorts, year-round residents, seasonal residents, day-users, Provincial Park visitors, fish habitat and may require property accusation and road re-alignment, we assume it will be done under Schedule B of the MCEA.

Under Schedule B of the MCEA the proponent is obligated to develop and implement a public consultation strategy. The stakeholder meeting held at Wolseley Lodge on May 30, 2019 was a positive first step. We look forward to participating in the April 6, 2021 council meeting to update the council on our interests and concerns and to learn how the Township will ensure a timely and comprehensive public consultation process.

There is one very important issue about the project that we are able to address immediately, and that we can share with you now. This is the issue of timing. At the May 30, 2019 meeting we learned that the project was scheduled to take place in the summer months. This was because the MNRF prohibits shoreline projects in the spring and the fall to protect spawning fish and their habitat. We completely understand and appreciate the need to protect fish habitat; after all, a healthy and sustainable fish population is integral to the commercial success of our resorts and our personal enjoyment of this vital natural resource. However, a July-August construction project would have a very significant negative impact on our resorts and many others that require bridge and boat launch access during the summer. We will address this in more detail at the April 6 council meeting.

The MNRF's prohibition on spring and fall shoreline projects is a default position if proponents wish to utilize the MCEA. The MCEA is intended to make the environmental assessment process less onerous and less costly for proponents, quicker and easier for the approving agencies, and still provide social, economic and environmental protection. The MNRF cannot possibly know with certainty that there are spring and fall spawning fish in the vicinity of all the shoreline areas across the province where a construction project may occur. Therefore, they assume that spring and fall spawning occurs, hence the blanket prohibition. It is up to the proponent to prove otherwise. By accepting the spring and fall development prohibition and conducting their project in the summer the proponent can save substantial time and money by not having to conduct a site-specific study to illustrate that spawning does not occur in the vicinity of their project. In this specific case,

the MNRF informed your project manager that Cisco may spawn in the fall in the vicinity of the Nature Trail bridge, and so the project cannot take place in the fall. Therefore, your project manager advised you that the bridge re-construction must be done in the summer.

In fact, there is a paucity of information on Cisco in inland waterways in Ontario. Specifically, the MNRF has no recent scientific information regarding the presence of Cisco in the Wolseley Bay area of the French River, and if Cisco are present, where and when they may spawn. The issue of project timing is so important to the Wolseley Bay stakeholders that we decided to proceed with an independent review of the relevant scientific, technical and popular literature to determine the status of Cisco in Wolseley Bay and if their presence and ecology impacts the Nature Trail bridge re-construction schedule.

The result of this literature review is the attached document, prepared by Cotyledon Environmental Consulting, entitled "*Cisco, or Lake Herring (Coregonus artedi) an Ecological Overview: in Relation to Wolseley Bay and the Wolseley Bay Area of the French River*". As a result of this review we accept that Cisco are present in the Wolseley Bay area of the French River; however, we conclude with certainty that they do not spawn in the vicinity of the Nature Trail bridge. It is also our opinion that this review document is both recent enough and sufficiently robust to meet the proponent's burden of proof that the MNRF's fall development prohibition is unwarranted, and therefore the Nature Trail bridge re-construction project can proceed in the fall under the MCEA.

In conclusion, the Wolseley Bay stakeholders are, in general, supportive of the re-construction of the Nature Trail bridge, although we have some outstanding concerns that need to be addressed. We look forward to working with you and the planning department to ensure a successful resolution. Specifically, there are no environmental constraints to a fall construction schedule.

Please contact me if you have questions regarding the Cisco Ecological Overview and how it relates to the MCEA.

Respectfully,

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We don't inherit this world from our parents, we borrow it from our children.

Cisco, or Lake Herring (*Coregonus artedi*)

An Ecological Overview: in Relation to Wolseley Bay and the Wolseley Bay Area of the French River

Prepared by Dave McLaughlin, BScF, MScF
Cotyledon Environmental Consulting
March 19, 2021

In consideration of the
Nature Trail Bridge Re-construction Project

Distribution

Cisco, or lake herring, are a member of the Lake Whitefish family. Many Whitefish and Cisco species are circumpolar in distribution. In Ontario, Cisco commonly occur in large, deep, cold water lakes and large river systems throughout the boreal and Great Lakes ecosystems. Historically, Cisco populations were very substantial in the Great Lakes, although deteriorating water quality, the introduction of competing invasive species, and commercial over-exploitation in the mid-1900s resulted in a catastrophic collapse of Cisco biomass, and near extirpation in Lake Erie.[44] Air and water pollution legislation and revised fisheries management agreements between Ontario and the U.S. Great Lakes states have resulted in substantial improvements in Great Lakes water quality, and as a result Cisco populations are rebounding.[46]

Where water quality has not been adversely affected and invasive species have not been introduced, Cisco populations in Ontario inland lakes and large river systems have remained robust.

Although the Ontario Ministry of Natural Resources and Forestry (MNRF) has no official population census data for Cisco in the French River, it is believed they are present. There are references to Cisco capture from the French River on ice fishing blogs. Similarly, sports fishing chat sites have referred to large baitfish schools marked on sonar believed to be Cisco, and commercial guides have reported incidental Cisco catches during both the ice and open water seasons. The MNRF caught Cisco during

index net fishing in the Dry Pine Bay area and concluded the species might be present throughout the French River system.[39] The anecdotal and on-line evidence, combined with the presence of expansive, deep, cold water habitat, suggests that Cisco are present in Wolseley Bay and the Wolseley Bay area of the French River, and that their population likely is substantial.

Species Variability and Description

Cisco exhibit an extreme degree of phenotypic plasticity across their range, meaning their appearance differs between lakes, and sometimes even within lakes.[14, 46] Cisco are so plastic in their phenotypic expression that almost every lake has their own nuanced variety.[14] Moreover, there is considerable environmental control over morphological expression, so that different year classes within a single body of water may differ significantly from one another in their shape, colour, and size.[46, 18, 19] This results in considerable confusion in the taxonomic literature, and at one time it was believed there were as many as 24 subspecies of cisco.[24] However, later it was concluded that there was insufficient basis for establishing these infra-species categories, and more recent genetic testing revealed they are all the same in terms of DNA.[18, 19] As recently as 1970 Cisco were considered a species complex and referred to as *'Coregonus artedii complex*'. Today, it is generally accepted among taxonomists and fishery scientists that the predominant Cisco species, or Lake Herring, present in inland lakes in Ontario's boreal and Great Lakes watersheds is *Coregonus artedi*.[46, 34]

Therefore, the Cisco present in Wolseley Bay and the Wolseley Bay area of the French River is *Coregonus artedi*.

Phenotypic and morphological variability not-with-standing, on average Cisco have an elongate body between 200 and 300 mm (8 to 12 inches) long, although this varies from lake to lake, and sometimes between areas within a lake.[46] Colouration is usually silvery with pink to purple iridescence. The colour of the back varies from lake to lake (or populations within large lakes) from almost black, to nearly any shade of blue or green, to gray or light tan, hence local names such as blueback and grayback. Regardless of back and side colouration, Cisco are white below.[46]

Cisco display a remarkable intra-ecosystem morphological plasticity not just with colouration. Within a lake when year-class populations are particularly abundant the adult fish tend to be smaller, and when they are less abundant they are larger in size.[14] This lake-specific population dimorphism was documented in North America (Wisconsin) and in Europe (Finland), suggesting this morphologic expression is species-wide.[18, 21]

On average Cisco are less than ½ kg (1 lb) in weight. The Ontario angling record for Cisco is 2.9 kg (4.3 lbs) caught in Corrine Lake near Hornepayne.[35] The Canadian angling record for Cisco is 3.4 kg (7.4 lbs) from Cedar Lake in Manitoba.[36]

For a small-bodied fish Cisco are relatively long lived, with an average lifespan of 6 to 10 years.[46] In inland lakes Cisco longevity may exceed 20 years, which is a considerable lifespan for a small fish that is low on the trophic scale, and is therefore a main food source for larger fish.[45]

Ecology

Cisco are pelagic, meaning they live and feed in open water environments. In the Great Lakes, where most of the Ontario research has been conducted, they typically school at depths from 18 to 53 m (60 to 174 ft), although in Lake Superior they have been netted as deep as 200 m (650 ft).[46, 11]

In inland lakes in the summer they live in large schools and forage in cold, oxygen-rich water below the thermocline, preferring a temperature range of 7º to 17º C (45º to 63º F).[6] The upper lethal temperature for young-of-the-year cisco is 26º and 24º C for adults (79º and 75º F). The lower lethal temperature approaches 0° C (32º F) for both young and adult cisco.[10] Temperatures of 13º to 18º C (55º to 64º F) are most suitable for sustained growth, net biomass gain, and minimal mortality.[33, 42, 14]

In general, Cisco move in spring and early summer from shallower to deeper water, looking for their preferred temperature below the thermocline. They remain in the cooler, deeper water until the seasonal lake turn-over, ranging from the lake bottom to just below the thermocline. As the upper water cools in the fall they move again into shallower water.[15] During the winter under the ice they can be found almost anywhere in the lake and at any depth, avoiding areas of low oxygen levels. In the day they form in large schools. At night the schools loosen or may dissolve altogether.

The spring seasonal migration was studied in Lake Nipissing, where it was observed that the entire population does not migrate downward into cooler water at the same time, but rather the movement occurs in an orderly sequence according to size and sex. The largest individuals of either sex migrate earliest, then slightly smaller males generally move out before the females. The youngest age groups move to the cooler depths last. Once the fish get into the cooler, deeper water they remain there until the fall turnover.[15]

High water clarity is not necessary for Cisco to thrive, but high water quality and biodiversity is. Robust populations of Cisco require clean, healthy, and biomass-rich lakes. Cisco thrive best in mesotrophic systems where water temperatures are moderate (but well stratified), oxygen levels are relatively high and stable through the year, and ecosystem nutrient levels support a robust biosphere.

Like many northern Ontario lakes and rivers, the water in Wolseley Bay and the Wolseley Bay area of the French River tends to be moderately dark-stained due to naturally occurring dissolved organic carbon. The Secchi Disk reading in mid-Wolseley Bay averages 3.3 m (11 ft), meaning you can see down into the water column more

than 3 m before a white-coloured object is lost from view. Both Wolseley Bay and the Wolseley Bay area of the French River are well oxygenated, and Wolseley Bay has a moderate nutrient loading, averaging 11.8 µg/L of total phosphorus during the open water season.[50] This classifies Wolseley Bay as *mesotrophic*. Mesotrophic water systems typically have high biomass production and high biodiversity. Open water nutrient levels are similar across the Wolseley Bay area, so this part of the French River is also mesotrophic.

Cisco eat plankton, zooplankton, insects and small invertebrates. Generally they are not fish-eaters, although larger individuals will occasionally eat small minnows.[46] In Lake Nipissing *Daphnia* and mayfly nymphs were important forage of Cisco in shallow water in the spring, while *Diaptomus oregonensis* (zooplankton, minute water insects) was the principal food in deep water.[46, 28] In the Great Lakes the crustaceans *Mysis* and *Pontoporeia,* copepods, and immature stages of aquatic insect groups, such as mayflies and caddisflies, were important adult food items.[40, 9] Even flying ants, apparently eaten at the surface, were reported for Lake Huron cisco specimens.[23] In northern Saskatchewan, zooplankton, *Mysis,* midge and mayfly larvae and water mites are important food items.[25]

Cisco move constantly, both laterally across the lake and up and down in the water column, keeping within their preferred temperature range. Although they will move into and out of deep water, they don't require deep water 'holes', any water depth below the thermocline that is within their preferred temperature is acceptable habitat. The fish form schools during the day, but disperse during the night. Schools, which are generally around 1 to 3 m tall in the water column (3 to 10 ft), tend to form below the light threshold at which their primary predators are able to detect prey. This is a predator-avoidance strategy and varies relative to the clarity of local lakes and the ecology of the major predator species. In clear water lakes where Lake Trout are the main predator the daytime Cisco schooling habitat is deeper, whereas the schools are shallower in stained lakes or where large Walleye, Pike and Muskie are the predators.

Ecologically, Cisco is to aquatic predators what the rabbit is to terrestrial predators. They are a significant food source for several species of fish higher on the trophic scale. In many lake ecosystems, Cisco are the predominant forage species for Lake Trout.[46, 32, 20] In fact, Lake Trout populations in many Ontario lakes probably would not exist without a robust population of Cisco to feed upon.[46] There are no Lake Trout in the Wolseley Bay area of the French River, but there are other apex predators that utilize Cisco as a major forage source.

In Wolseley Bay and the Wolseley Bay area of the French River there are substantial populations of Walleye, Northern Pike, and Muskie. Although these predator fish are generally considered to be warm water species foraging and resting above the thermocline, in the summer larger individuals routinely suspend in the cold water pelagic region in search of schools of Cisco, on which they feed voraciously. Also, in the spring, fall and winter when water temperatures are favourable for Cisco to venture into shallow

water, they become susceptible to predation from Walleye, Pike, Bowfin and Muskie of all sizes. In Wolseley Bay and elsewhere in the French River system, Cisco may be the predominant forage of sexually mature, large, Muskie. In fact, the presence of abundant Cisco is likely a contributing factor to the French River being known as a trophy Muskie fishery.

Spawning and Egg Development

Cisco are non-guarder pelagophils, meaning they broadcast their eggs in the open water stratum and abandon them; there is no parental protection.[46]

Cisco typically spawn in the late fall to early winter, and their eggs incubate under the ice and hatch in early spring.[8, 38, 16] In the Great Lakes, where Cisco biology is better researched, spawning occurs in November or early December in nearshore areas ranging in depth from 10 to 60 m (33 to 200 ft) and deeper.[46] In the Bay of Quinte in Lake Ontario, Cisco were observed to spawn during the last two weeks of November and the first week of December. The eggs are deposited in rock crevices in water from 2 to 3 m in depth (7 to 10 ft).[16]

Much less is known about Cisco spawning in Ontario inland lakes. In large, deep lakes spawning occurs in nearshore areas at depths usually less than 20 m (66 ft).[16] In smaller lakes and river systems spawning usually takes place in shallow inshore water between 1 and 3 m deep (3 to 10 ft).[46]

In inland lakes spawning is usually underway when ice begins to form around the shores, making it difficult to study and observe spawning behavior.[46]

The timing of spawning is highly dependent on water temperature.[14] Because of their extensive range and variable lake habitats, commencement of spawning can vary geographically by several weeks. Generally, in the Great Lakes and inland lakes of Ontario, spawning occurs in November or December when water temperatures range between 1º and 5º C (34º to 41º F).[46] In Wisconsin spawning begins at temperatures around 4º C (39º F) but reaches its peak at about 3º C (37º F).[5] In Manitoba Cisco begin to gather over reefs in the fall when the water temperature falls below 5º C (41º F) and spawning occurs in water between 3º and 4º C (37º to 39º F).[47]

Selection of spawning sites is lake-specific, meaning they are not biologically predisposed to a specific spawning environment, although preferences are evident. This is likely related to their extreme morphological and phenotypical plasticity, where adaptation permits Cisco populations to adjust to local environmental conditions.

Silt, sediment, dead leaves, vegetation, and/or filamentous algae are unacceptable and Cisco will not utilize these areas for reproductive purposes.[37] They do not utilize submergent or emergent vegetation. Although they have been observed to spawn over almost any non-vegetated substrate, even open-water pelagic dispersal, they tend not

to utilize bedrock, are less likely to spawn over boulders, silt, clay or hardpan bottoms, and are more likely to spawn over cobble, rubble, gravel and sand.[27] Also, in inland lakes, Cisco show an affinity towards spawning in near-shore environments rather than streams or rivers. However, where Cisco inhabit large river systems, such as St. Mary's River and large tributaries of Hudson Bay, spawning will occur in modest currents.[3, 16, 26] Larger substrate sizes like cobble and gravel benefit broadcast spawners like Cisco by providing protected and oxygenated sites for eggs during incubation.[17]

Cisco spawn at night. A full moon that coincides with ideal water temperatures will often spur significant spawning movements. Anecdotal observations (blog sites and popular literature) and some researchers have reported Cisco boiling on the surface during a spawning event under a full moon.[2]

Because Cisco spawn in the late fall, ice may be an important factor in egg survivability. Post-spawn ice cover protects incubating eggs from exposure to wind and wave action during the winter, thereby minimizing siltation and subsequent suffocation. Areas that are more exposed to the elements, such as ice-free shores or river mouths, or stretches of current, suffer higher egg mortality.[48, 13] Too much current may lower egg viability through egg burial and physical disturbance, particularly for broadcast spawners like cisco.[30]

Ice concentration, cover, thickness and the time of ice-on and ice-off varies significantly across the Great Lakes and inland lakes. Ice, along with substrate and temperature, may be helpful in finding potential Cisco spawning sites.[1, 31, 41] In a study to determine potential Cisco spawning sites in Lake Erie, accuracy was highest for sites with an ice cover duration between 56 and 70 days, a sand substrate, and a date of first ice on or before January 13.[44]

Egg development proceeds slowly at low winter water temperatures.[46] It is unlikely that hatching occurs under the ice, although few studies are available. Hatching probably occurs during or after the spring breakup.[22] Under experimental conditions the optimal egg incubation water temperature was 5.6º C (42º F). Winter water temperatures in most Ontario inland lakes are lower than this threshold, likely increasing the incubation period.[7] In the same experiments it took Cisco eggs 92 days to hatch at 5.6º C, 106 days at 5.0º C, and 236 days at 0.5º C.[7]

Site disturbance, fluctuations in water levels, temperature and oxygen levels, and predation contribute to egg mortality. In the St. Mary's River Cisco egg survival averaged 64%, and in Lake Michigan it averaged 66%.[30, 43] In these systems the dissolved oxygen content in the water was about 15 mg/L, which is typical for large river and lake systems in the winter. In smaller, shallow inland lakes that freeze over completely and have a large amount of decaying plant matter the dissolved oxygen levels can fall in the winter. Dissolved oxygen levels below 2 mg/L can have an adverse effect on Cisco egg survival.[4]

Cisco eggs likely hatch in late April and early May, the period of incubation depending largely on water temperature. The newly emerged fry school in shallow, protected bays for about one month, after which they move into deeper water and assume their pelagic lifestyle. The fry begin feeding when they are about ten days old, their food consisting chiefly of algae, copepods and cladocerans (crustaceans such as water fleas).

Likelihood of Cisco in Wolseley Bay and the Wolseley Bay Area of the French River

Although no official research or angling census exists, there is no doubt Cisco are present in Wolseley Bay and the Wolseley Bay area of the French River, and that the population is likely substantial. The Wolseley Bay area, even though it is part of the French River, has the characteristics of a large lake. The Wolseley Bay area is about 2,300 ha (5,680 ac) in size, more than 25 km (15 miles) long, has about 281 km (174 miles) of shoreline, is more than 36 m (120 feet) deep in areas, and there are 77 islands greater than 1/3 ha (3/4 ac) in size. The water quality is good, it is well oxygenated and has a moderate nutrient loading. Mesotrophic systems like the Wolseley Bay area typically have high biomass production and high biodiversity. Wolseley Bay and the Wolseley Bay area of the French River are thermally stratified during the summer, so there is abundant cold water habitat for a pelagic fish like Cisco. Furthermore, because of the size of the Wolseley Bay area and the expanse of suitable habitat, there is almost certainly several populations of Cisco that live, forage, and breed in different areas of this section of the French River.

Likelihood of Cisco Spawning at the Mouth of the Wolseley River

There are many creeks that flow into Wolseley Bay and the Wolseley Bay area of the French River, but the main inputs are the massive upstream flow of the French River with its origin in Lake Nipissing, the Wolseley River and the Restoule River. The Wolseley River is a major spawning area for many fish species. The Nature Trail bridge crosses the Wolseley River at its mouth, where it enters the northwest end of Wolseley Bay. The generic MNRF work permit prohibits work on waterfront infrastructure projects, like the Nature Trail bridge, between October 1 and July 15 to protect fall spawning and spring hatching fish species like Cisco, Lake Whitefish, Lake Trout, Brook Trout, and Rainbow Trout, and April 1 to July 15 to protect spring spawners such as Panfish, Bass, Walleye, Pike and Muskie. There is no question Panfish, Bass, Walleye, Pike and Muskie utilize the lower stretch of the Wolseley River for spawning, including the immediate area of the river mouth by the Nature Trail bridge. These species are routinely seen and commonly caught in the area. In contrast, there is no official or anecdotal evidence of Cisco being seen, caught, or spawning in the Wolseley River in the vicinity of the river mouth by the Nature Trail bridge. As previously concluded, there are robust populations of Cisco in Wolseley Bay and the Wolseley Bay area of the French River. However, it is virtually a certainty that Cisco do not spawn at the mouth of the Wolseley River in the immediate vicinity of the Nature Trail bridge. There are no Lake Whitefish, Lake Trout, Brook Trout, or Rainbow Trout populations in Wolseley Bay,

or elsewhere in the French River system, so in this case the fall construction prohibition is intended to protect spawning Cisco.

The river mouth by the bridge has a considerable current, particularly in times of high water, which is typical in the spring and the late fall. Because of the current, and the slightly warmer water from the river watershed, the lower stretch of the Wolseley River, particularly around the river mouth, remains ice-free for most of the winter. This area will freeze over with thin ice during prolonged periods of ambient air temperatures of -20º C or colder, only to re-open when the temperature rises. The winter open water reaches to the Totem Point Lodge docks, about 110 m from the Nature Trail bridge. In the winter and spring there is a current back-eddy that circulates clockwise under the ice that forms around the Wolseley Lodge docks.[39]

There is a water level and temperature gauge operated by Environment Canada adjacent to and slightly downstream of the Nature Trail bridge, in the immediate vicinity of the proposed bridge reconstruction (Sample Station 02DD026, latitude 46º 06' 20" N, longitude 80º 15' 55" W, about 70 m from the construction site). The warmer water discharged from the Wolseley River may not achieve the optimal temperature to trigger Cisco spawning until late December or early January.[49] From the period October 1, 2018 to March 31, 2019 the water temperature from this monitoring site did not reach 6º C until November 23, 5º C until December 8 (Cisco congregate on spawning sites), and 4º C until January 1 (Cisco spawning may commence). It did not reach 3º C at all during the fall/winter/spring of 2018/19, which some literature suggests is the optimal Cisco spawning temperature.

The fisheries literature concludes that Cisco will utilize a wide range of sites for spawning, but they have a preference for near-shore, sand or cobble substrate, with little or no current, and a winter-long ice cover that prevents disturbance of the water column over the broadcasted eggs. There are many near-shore environments around Wolseley Bay that are suitable Cisco spawning sites. If cisco spawn in the northwest arm of Wolseley Bay it is a certainly that it is not at the river mouth in the vicinity of the Nature Trail bridge. It is far more likely spawning occurs along the north shoreline east of Totem Point Lodge (~640 m from the bridge), or the bay around the point and southeast of Wolseley Lodge (~400 m), the mouth of Saw Mill Bay (~ 1.0 km), the mouth of Sturgeon Bay (~3.0 km), or the mouth of Pine Cove Bay (~3.3 km). These possible spawning sites are illustrated in the attached figure.

Since there are no other fall spawning fish species, for example Lake Trout, Brook Trout, Rainbow Trout or Lake Whitefish in Wolseley Bay, there is no ecological reason to prohibit bridge re-construction in the October/November time period. Even if by some remote possibility Cisco do spawn at the mouth of the Wolseley River by the bridge, *which is contrary to the conclusion of this ecological review*, optimal water temperatures for spawning would not be reached until December or even later, which would still permit an October/November construction project.

Executive Summary

- Cisco are circumpolar in distribution.
- In Ontario Cisco occur throughout the Great Lakes and many inland lakes and large river systems.
- There is no official MNRF record of Cisco in the French River system; however based on anecdotal and on-line and popular literature it is concluded that Cisco are present in the Wolseley Bay area of the French River, and the population is robust.
- Cisco display a substantial degree of phenotypic and morphological plasticity, which originally lead to the false belief that there were many species, sub-species, and varieties of Cisco; however, based on recent DNA data it is currently accepted that the predominant species of Cisco in Ontario, and therefore the Wolseley Bay area, is *Coregonus artedi*.
- Cisco are schooling, pelagic, cold water fish that feed predominantly on plankton and zooplankton; they are small, averaging 200 to 300 mm in length, but individuals may exceed 2 to 3 kg.
- In the Wolseley Bay area Cisco may be the dominant forage fish of large, sexually mature Muskie, which likely contributes to the trophy Muskie status of this water.
- There is a paucity of literature regarding Cisco spawning ecology in inland lakes in Ontario; they are non-guarding pelagophils that have a preference for;
    - near-shore areas less than 3 m in depth,
    - little or no current,
    - gravelly, sandy, or coble substrate,
    - water temperature between 3^{o} and 5^{o} C, and
    - consistent, winter-long ice cover.
- It is a certainty that Cisco do not spawn at the mouth of the Wolseley River in the immediate vicinity of the proposed Nature trail bridge reconstruction project because;
    - there is a constant and considerable current,
    - the ice cover is periodic and absent for much of the winter season, resulting in poor egg incubation conditions,
    - the optimal water temperature range of 3^{o} to 4^{o} C is not reached until January, and 3^{o} may only be rarely reached, if at all (it wasn't in the 2018/19 winter), and
    - there are several more suitable spawning areas in the northwest arm of Wolseley Bay.
- There is no ecological reason why the Nature Trail bridge reconstruction project cannot proceed in the fall, as there are no fish species that spawn in the area at that time.
- Furthermore, a fall construction schedule would minimize the economic impact on resorts, residents, cottagers and recreational users of Wolseley Bay, the Wolseley Bay area, and the French River Provincial Park.

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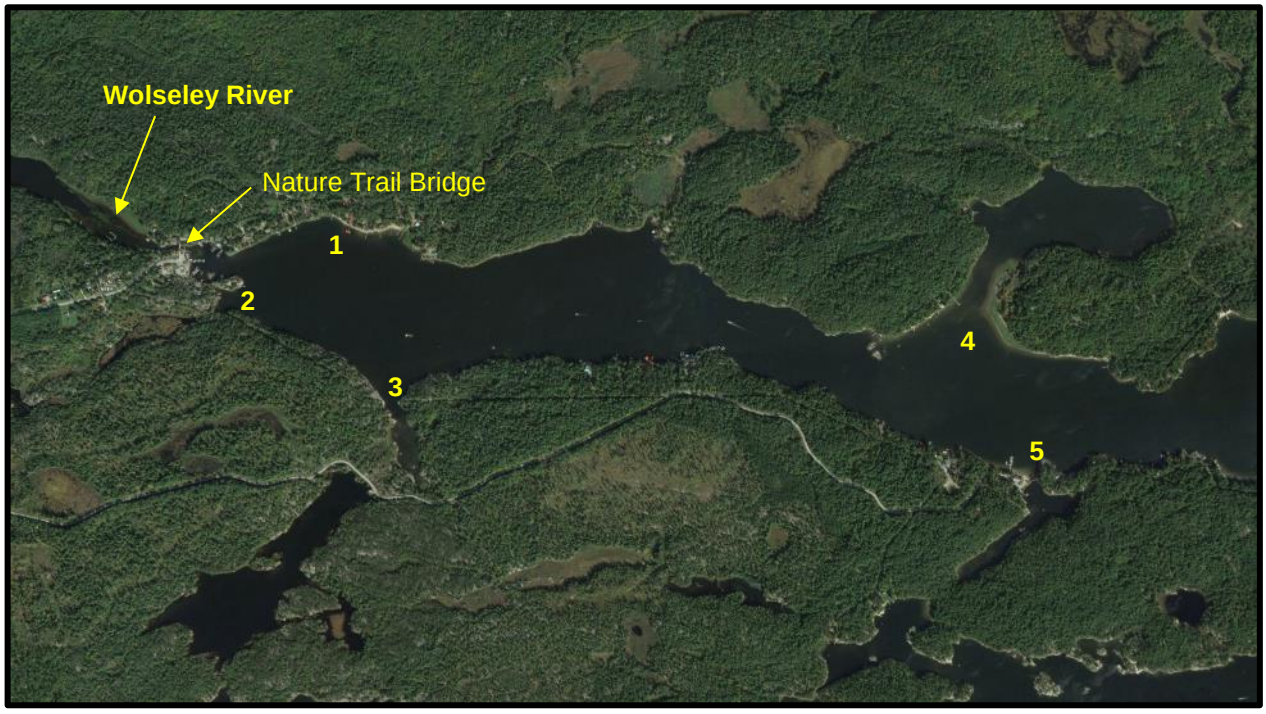

Possible cisco spawning areas in Wolseley Bay, based on local knowledge and Schaefer, 2019 and Lane et. al., 1996. There are other possible cisco spawning sites elsewhere in the Wolseley Bay area of the French River. Image from Google Earth (2018).

1. Sandy/gravelly shoreline northeast of Totem Point Lodge.
2. Unnamed bay past the point and southeast of Wolseley Lodge.
3. Mouth of Saw Mill Bay.
4. Mouth of Sturgeon Bay.
5. Mouth of Pine Cove Bay.