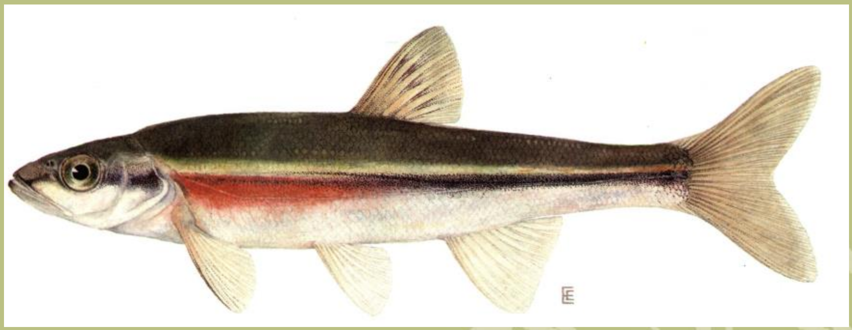
Species at Risk Act
Recovery Strategy Series

Recovery Strategy and Action Plan for the Redside Dace (*Clinostomus elongatus*) in Canada

Redside Dace



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For copies of the recovery strategy and action plan, or for additional information on species at risk, including Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports and other related documents, please visit the Species at Risk Public Registry.

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Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for the protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies and action plans for listed extirpated, endangered, or threatened species and are required to report on progress 5 years after the publication of the final document on the Species at Risk Public Registry.

This document has been prepared to meet the requirements under SARA of both a recovery strategy and an action plan. As such, it provides both the strategic direction for the recovery of the species, including the population and distribution objectives for the species, as well as the more detailed recovery measures to support this strategic direction, outlining what is required to achieve the objectives. SARA requires that an action plan also include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation. It is important to note that the setting of population and distribution objectives and the identification of critical habitat are science-based exercises and that socio-economic factors were not considered in their development. The socio-economic evaluation only applies to the more detailed recovery measures.

The Minister of Fisheries and Oceans and the Minister responsible for Parks Canada are the competent ministers under SARA for Redside Dace and have prepared this recovery strategy and action plan, as per sections 37 and 47 of SARA. This document has been prepared in cooperation with the Government of Ontario, particularly the Ontario Ministry of Natural Resources and Forestry, with much of this document having been synthesized from “Ontario Recovery Strategy for the Redside Dace (*Clinostomus elongatus*) in Ontario” (Redside Dace Recovery Team 2010).

As stated in the preamble to SARA, success in the recovery of this species depends on the commitment and cooperation of many different groups that will be involved in implementing the directions set out in this recovery strategy and action plan and will not be achieved by Fisheries and Oceans Canada (DFO), or any other jurisdiction, alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing this recovery strategy and action plan for the benefit of Redside Dace and Canadian society as a whole.

Implementation of this recovery strategy and action plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

DFO would like to thank the earlier Redside Dace Recovery Team and the Government of Ontario for their central roles in preparing the provincial recovery strategy for Redside Dace (produced in 2010), upon which the present document is based. DFO would also like to acknowledge the many contributions to Redside Dace conservation by the late Dr. Alan Dextrase of the Ontario Ministry of Natural Resources and Forestry (OMNRF), as the former chair of the provincial Redside Dace Recovery Team. In addition, we would like to thank the following organizations for their contributions to the project (as members of the Redside Dace Recovery Implementation Team): OMNRF; Ontario Ministry of Environment, Conservation and Parks; Ontario Streams; Ausable-Bayfield Conservation Authority; Conservation Halton; Credit Valley Conservation; Toronto and Region Conservation Authority; Lake Simcoe Region Conservation Authority; Central Lake Ontario Conservation Authority; Toronto Zoo; and the Royal Ontario Museum. Written contributions were made by Shawn Staton (DFO), Pat Dimond (DFO contractor), Josh Stacey (DFO), Mark Heaton (Ontario Streams), and Amy Boyko (DFO), and mapping was produced by Andrew Geraghty (DFO).

Executive summary

The Redside Dace was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered in 2007 and again in 2017; the species was listed as endangered under the *Species at Risk Act* (SARA) in 2017. This recovery strategy and action plan is considered one in a series of documents for this species that are linked and should be taken into consideration together, including the COSEWIC status report, a recovery potential assessment, the action plan for the Rouge National Urban Park, which includes Redside Dace, and possibly further action plans. Recovery has been determined to be biologically and technically feasible.

The Redside Dace is a small colourful leuciscid (minnow family) that lives in rivers and streams in the southern Great Lakes basin, the upper Mississippi drainage, and the upper Susquehanna River drainage. In Canada, Redside Dace is found primarily in southern Ontario where it most frequently occurs in streams flowing into western Lake Ontario. It is also found in a few streams that drain into Lake Huron, Lake Erie, and Lake Simcoe.

Redside Dace populations have been lost from several tributaries to western Lake Ontario, and the extent of several remaining populations has been reduced within watersheds. Most of Canada's Redside Dace populations are found in the "Golden Horseshoe Region" of Ontario, which is an area that is rapidly being developed. Urban development is considered to be the most significant threat acting upon Redside Dace populations in Ontario.

The main threats facing the species are described in section 5 and include residential/ commercial development, agriculture, pollution, natural system modifications, invasive species, human intrusion, biological resource use, and climate change.

The population and distribution objectives for Redside Dace are:

- Long-term population objective: To ensure that all populations and sub-populations (both extant and historical) within the 17 watersheds listed below demonstrate signs of reproduction and recruitment, and are stable or increasing with low risk from known threats. Note that the inclusion of historical populations within this objective is limited only to locations where feasible and warranted.

- Long-term distribution objective: To ensure the survival of self-sustaining populations/sub-populations within currently and, where feasible and warranted, historically occupied reaches within the following watersheds:

  1. Lynde Creek
  2. Carruthers Creek
  3. Duffins Creek
  4. Rouge River
  5. Don River
  6. Humber River
  7. Credit River
  8. Sixteen Mile Creek
  9. Fourteen Mile Creek
  10. Bronte Creek
  11. Spencer Creek

12. Holland River
13. Irvine Creek
14. Gully Creek
15. Saugeen River
16. Unknown Stan J
17. Two Tree River

The action plan portion of this document provides the detailed recovery planning in support of the strategic direction set out in the recovery strategy section of the document. The action plan outlines what is required to achieve the population and distribution objectives, including the measures to be taken to address threats and to monitor recovery of the species, as well as the measures required to protect critical habitat. Socio-economic impacts of implementing the action plan are also evaluated.

For Redside Dace, critical habitat (section 8) is identified to the extent possible, using the best available information, and provides the features necessary to support the species' life-cycle functions, and to achieve the species' population and distribution objectives. This recovery strategy and action plan identifies stream reaches where critical habitat for Redside Dace exists in the watersheds listed above.

Recovery feasibility summary

Recovery of the Redside Dace is believed to be both biologically and technically feasible. The following feasibility criteria[1] have been met for the species:

1. Individuals of Redside Dace that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

    Yes. Reproducing populations exist within the following Ontario watersheds: Two Tree River, Saugeen River, Gully Creek, Unknown Stan J, Fourteen Mile Creek, Sixteen Mile Creek, Credit River, Humber River, Rouge River, Duffins Creek, and Carruthers Creek.

2. Sufficient suitable habitat is available to support these species or could be made available through habitat management or restoration.

    Yes. The restoration of degraded habitats within many occupied watersheds is possible and viable populations supported by reasonable habitat already occur within some watersheds.

3. The primary threats to the species or its habitats (including threats outside Canada) can be avoided or mitigated.

    Yes. Urban development and agricultural activities can be conducted in ways that mitigate threat factors to Redside Dace habitat.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

    Yes. Mitigation techniques for general threats to stream ecosystems are relatively well studied and have been demonstrated to be effective when done correctly. Low impact development promotes infiltration of rainfall and effective erosion and sediment controls, and monitoring reduces sediment releases from urban construction. Nutrient loading is reduced through the use of rural best management practices such as vegetated stream buffers, and retrofitting of existing stormwater management ponds to bottom draw, resulting in cooler discharge temperatures that are more suitable for the species.

[1] Government of Canada. 2009. *Species at Risk Act* Policies [Draft]. *Species at Risk Act*, Policies and Guidelines Series. Ottawa, Ontario. Environment Canada. 48 pp.

Table of contents

1 Introduction

Redside Dace (*Clinostomus elongatus*) was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered in 2007 and again in 2017; the species was then listed as endangered on schedule 1 of the *Species at Risk Act* (SARA) in 2017.

The "Recovery Strategy and Action Plan for the Redside Dace (Clinostomus elongatus) in Canada" is part of a series of documents regarding Redside Dace that should be taken into consideration together, including the latest COSEWIC status report (COSEWIC 2017) and the Science Advisory Report from the recovery potential assessment (RPA) (Fisheries and Oceans Canada [DFO] 2019), and the action plan for the Rouge National Urban Park, which includes Redside Dace (Parks Canada Agency 2021). Much of this document has been synthesized from "Ontario Recovery Strategy for the Redside Dace (Clinostomus elongatus) in Ontario" (Redside Dace Recovery Team 2010), in particular information related to the threats, recovery approaches, and critical habitat identification.

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets objectives and identifies the main activities to be undertaken, while the action plan portion provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy portion. Action planning for species at risk recovery is an iterative process; hence, the implementation schedule (tables 5 to 7) in this recovery strategy and action plan may be modified in the future depending on the progression towards recovery.

The RPA is a process undertaken by DFO Science to provide the information and scientific advice required to implement SARA, relying on the best available scientific information, data analyses, modelling, and expert opinions. The outcome of this process informs many sections of the recovery strategy and action plan. For more detailed information beyond what is presented in the recovery strategy and action plan, refer to the COSEWIC status report (COSEWIC 2017) and the RPA science advisory report (DFO 2019).

2 COSEWIC species assessment information

Date of assessment: April 2007
Common name (population): Redside Dace
Scientific name: *Clinostomus elongatus* (Kirtland, 1840)
COSEWIC status: Endangered
Reason for designation: This species is especially sensitive to stream alterations that interfere with flow regimes and lead to increased siltation and water temperatures. It has been lost from 5 of its 24 historic locations, and may now be gone from an additional 5; continuing decline is evident in 8 of the 14 remaining locations. More than 80% of the Canadian distribution occurs in the 'Golden Horseshoe Region' of southwestern Ontario where urban development poses the most immediate threat to the continued existence of this species in Canada. The 6 stable populations are on the fringe of urban development in watersheds that are, as yet, relatively undisturbed, but more than 50% of these locations are in, or adjacent to, areas that are expected to be developed within the next 10 to 15 years.
Canadian occurrence: Ontario
COSEWIC status history: Designated special concern in April 1987. Status re-examined and designated endangered in April 2007. Last assessment based on an update status report.

Date of assessment: November 2017
Common name (population): Redside Dace
Scientific name: *Clinostomus elongatus* (Kirtland, 1840)
COSEWIC status: Endangered
Reason for designation: This small, colourful minnow is highly susceptible to changes in stream flow and declines in water quality, such as occur in urban and agricultural watersheds. The Canadian range of this species largely overlaps with the Greater Toronto Area (GTA), where urban land use is widespread and projected to increase in the future. The continued expansion of the GTA has led to ongoing habitat degradation, causing serious declines in range and number of individuals and populations.
Canadian occurrence: Ontario
COSEWIC status history: Designated special concern in April 1987. Status re-examined and designated endangered in April 2007 and November 2017.

3 Species status information

Table 1. Summary of existing protection or other status designations assigned to the Redside Dace.

Jurisdiction	Authority/ organization	Year(s) assessed and/or listed	Status/description	Designation level
Ontario	Committee on the Status of Species at Risk in Ontario	2020	Endangered	Species
Ontario	*Endangered Species Act, 2007*	2009	Endangered	Species
Ontario	NatureServe	2017	S1 (Critically imperilled)	Population

Jurisdiction	Authority/ organization	Year(s) assessed and/or listed	Status/description	Designation level
Canada	Committee on the Status of Endangered Wildlife in Canada	2007 and 2017	Endangered	Species
Canada	*Species at Risk Act*	2017	Endangered	Species
Canada	NatureServe	2011	N1 (Critically imperilled)	Population
United States[2]	NatureServe	2007	N3N4 (Vulnerable/apparently secure)	Population
International	NatureServe	2011	G3 (Vulnerable)	Species
International	International Union for Conservation of Nature	2011	Least concern	Species

Upon listing as an endangered species, Redside Dace became protected wherever it is found in Canada by section 32 of SARA:

> "No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species." [subsection 32(1)]

> "No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual." [subsection 32(2)]

Under section 73 of SARA, the competent minister may enter into an agreement or issue a permit authorizing a person to engage in an activity affecting a listed wildlife species, any part of its critical habitat, or its residences, as long as the activity will not jeopardize the survival or recovery of the species.

4 Species information

4.1 Description

The Redside Dace is a small insectivorous fish (average length 7.5 cm, maximum 12 cm) (see figure 1). During spawning, individuals of this species develop a bright red stripe along the front half of their body, below a vivid yellow stripe. The species possesses a large mouth with a protruding jaw (COSEWIC 2017) adapted for surface feeding on insect prey items. The Redside Dace can be found in slow-moving sections of rivers and streams (0.5 to 20 m wide) (Ontario Ministry of Natural Resources and Forestry [OMNRF], unpubl. data) in Ontario, and likely plays an important ecosystem role in that it transfers terrestrial energy into the aquatic environment. Further species information can be found in the COSEWIC status report (COSEWIC 2017).

[2] Refer to NatureServe (2022) for state-specific designations.

Figure 1. Redside Dace (Fisheries and Oceans Canada).

4.2 Population abundance and distribution

Global distribution and population abundance: The global range of the Redside Dace is found entirely within North America, where the species has a discontinuous range. In the west, Redside Dace is found in the upper Mississippi basin in Minnesota, and the upper Mississippi and Lake Michigan watersheds of Wisconsin. In the east, it occurs in a wide band south of Lake Erie and Lake Ontario, as well as in parts of Michigan and Ontario (figure 2).

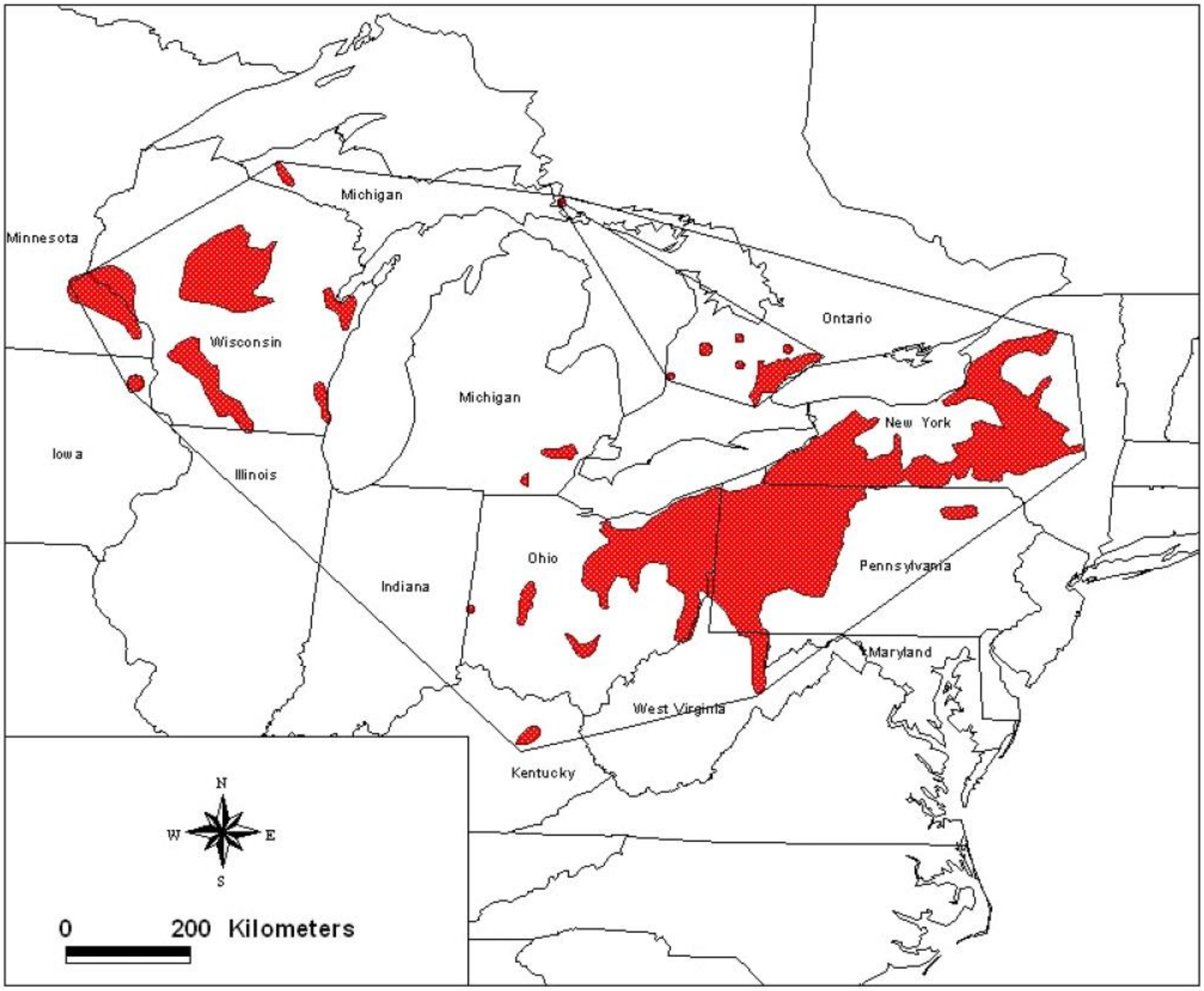

Figure 2. Global distribution of the Redside Dace (red shaded area) (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2017). Global distribution captured by larger polygon, Canadian distribution is captured by smaller polygon within the larger polygon. Figure used with permission from COSEWIC.

Canadian distribution and population abundance: The current Canadian distribution of Redside Dace is limited to southern Ontario and the Two Tree River on St. Joseph Island (figure 3). Most populations occur in tributaries to western Lake Ontario from Spencer Creek in the west, to Lynde Creek in the east. Populations are also known from the Holland River system (Lake Simcoe drainage), the Saugeen River system, Gully Creek, Unknown Stan J (Lake Huron drainages), and Irvine Creek (Lake Erie drainage) (Parker et al. 1988; Mandrak and Crossman 1992; COSEWIC 2017; Gáspárdy et al. 2021; Gáspárdy and Drake 2021). Canadian populations have experienced a continuing decline over the last 50 years, and only a few populations could currently be considered to be healthy. Redside Dace populations have been lost from several tributaries to western Lake Ontario and the length of stream occupied by several populations has been drastically reduced (Parker et al. 1988; Redside Dace Recovery Team 2010; COSEWIC 2017). Since the publication of the 2007 COSEWIC report (COSEWIC 2007), the boundaries of the overall range (extent of occurrence) of Redside Dace in Canada have declined by 4.4% (COSEWIC 2017).

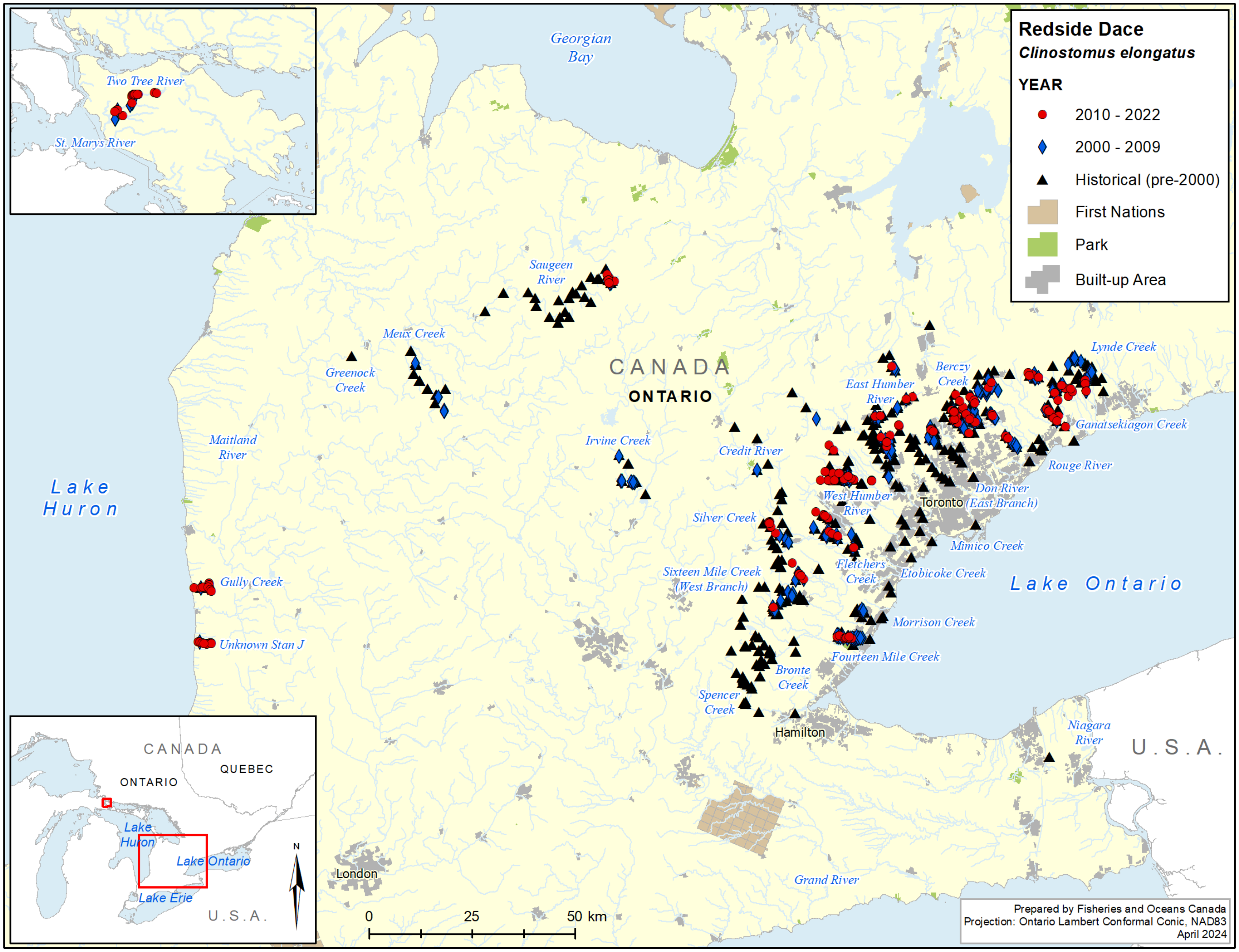

Figure 3. Canadian distribution of Redside Dace. Note that all data displayed on the map include data up until 2022, with the exception of the Saugeen River, which includes data up until 2023.

Redside Dace has been captured from over 60 streams or sections of rivers in 25 watersheds in Ontario. A summary of available data indicates that the species was still extant in 34 streams in 16 watersheds from 1980 to 2002 (COSEWIC 2007); since 2007, it has been found in 2 additional watersheds. Overall, it has been extirpated from the following 9 watersheds: unknown creek in Clarkson, Etobicoke Creek, Highland Creek, Mimico Creek, Morrison Creek, Pringle Creek, Petticoat Creek, Wedgewood Creek, and a stream on an island in the Welland Canal (DFO 2019). The species may also be extirpated from 3 other drainages: Spencer Creek, Bronte Creek, and Irvine Creek (Barnucz and Drake 2021). Sampling efforts targeting historical Redside Dace sites indicate that the abundance and range of many of the extant populations have been reduced, in some cases dramatically. For example, in the upper Saugeen River, Redside Dace was recorded in a stream stretch of approximately 40 km at 26 sites in 1951, and over 100 individuals were captured from Meux Creek (Saugeen River tributary) in 1985. However, sampling in the Saugeen River in 1985 and 2000 at most of the historical sites found it at only 3 sites in a 3 km stretch, and extensive sampling of Meux Creek in 2004 resulted in the capture of 1 Redside Dace. Since 2000, only 20 individuals have been captured from historical sites in the Saugeen River (DFO 2019). Sampling conducted in 2023 captured 74 Redside Dace from 12 sites in the Saugeen (sites located near Wareham); however, no individuals were captured in Meux Creek (DFO, unpubl. data). In Spencer Creek, it was found in scattered locations in a stream stretch of approximately 18 km in the early 1970s. Intensive sampling from 1997 to 2001 and in 2018 at historical sites produced only a single specimen and, despite several sampling attempts, it has not been collected from Spencer Creek since 1998 and Flamborough Creek since 1984 (DFO 2019; Barnucz and Drake 2021). Reductions in range and abundance have also occurred in other watersheds such as Lynde Creek, the Credit River, Don River, Humber River, Duffins Creek, Holland River (Kettleby and Sharon creeks), and the Rouge River. For further information regarding the status of populations within specific Canadian watersheds, refer to the Science Advisory Report from the RPA (DFO 2019).

Population assessment (table 2): The status of Redside Dace populations in Canada was assessed by Lebrun et al. (2020). Populations were ranked in terms of their abundance and trajectory (that is, increasing, stable, decreasing). Certainty assigned to each population status is reflective of the lowest level of certainty associated with population abundance or trajectory. Refer to Lebrun et al. (2020) for detailed methods used for the assessment of population status.

Table 2. Population status and associated certainty of individual Redside Dace populations in Canada. Adapted from Lebrun et al. (2020).

Drainage	Population	Population status	Certainty[3]
Lake Ontario	Pringle Creek	Extirpated	3
Lake Ontario	Lynde Creek	Poor	2
Lake Ontario	Carruthers Creek	Fair	2
Lake Ontario	Duffins Creek	Poor	2
Lake Ontario	Petticoat Creek	Extirpated	3
Lake Ontario	Highland Creek	Extirpated	3
Lake Ontario	Rouge River	Poor	2
Lake Ontario	Don River	Poor[4]	2
Lake Ontario	Humber River	Fair	2
Lake Ontario	Mimico Creek	Extirpated	3
Lake Ontario	Etobicoke Creek	Extirpated	3
Lake Ontario	Unknown creek in Clarkson	Extirpated	3
Lake Ontario	Credit River	Poor	2
Lake Ontario	Morrison Creek	Extirpated	2
Lake Ontario	Sixteen Mile Creek	Poor	2
Lake Ontario	Fourteen Mile Creek	Fair	2
Lake Ontario	Bronte Creek	Poor[4]	3
Lake Ontario	Wedgewood Creek	Extirpated	3
Lake Ontario	Spencer Creek	Poor[4]	2
Lake Ontario	Niagara area stream	Extirpated	3
Lake Simcoe	Holland River	Poor	2
Lake Erie	Irvine Creek	Poor	3
Lake Huron	Gully Creek	Poor	2
Lake Huron	Saugeen River	Poor	2
Lake Huron	Unknown Stan J	Unknown	3
Lake Huron	Two Tree River	Fair	2

4.3 Needs of the Redside Dace

Habitat and biological needs

Spawn to hatch: Typically, the Redside Dace is sexually mature at 2 years, but spawning may not occur until its third year. Maximum age is 5 years (DFO 2019), with individuals occasionally surviving longer (Indiana Department of Natural Resources 2012). The oldest captive specimen at the Toronto Zoo lived to 7 years (C. Lee, Toronto Zoo, pers. comm. 2020). Fecundity ranges from 409 to 1,526 eggs, based on 15 individuals from northern New York (Scott and Crossman 1973). Spawning occurs when water temperature reaches 16 to 18°C, typically in May on gravely riffles (Koster 1939; COSEWIC 2017). Eggs are deposited in gravel nests of Creek

[3] Certainty is listed as: 1=quantitative analysis, 2=catch per unit effort or standardized sampling, 3=expert opinion.
[4] Likely extirpated as of 2020.

Chub (*Semotilus atromaculatus*) and/or Common Shiner (*Luxilus cornutus*), synchronizing its spawning with that of these 2 species. This strategy contributes to increased egg survivorship of the Redside Dace through the protection afforded by the guarding behaviour of the parental Creek Chub or Common Shiner. The guarding fish keep the nest free of silt and protect the eggs from predation. However, males of both Creek Chub and Common Shiner have been observed consuming the eggs of Redside Dace (E. Holm, Royal Ontario Museum, pers. comm. 2020). Creek Chub and Common Shiner are ubiquitous in southern Ontario streams but initiate spawning at slightly cooler temperatures (12 to 17°C) than the preferred spawning temperature for the Redside Dace (16 to 18°C) (COSEWIC 2017). However, spawning-ready female Redside Dace have been collected from Minnesota streams at temperatures as low as 10.8°C and up to 15°C (Dieterman 2018).

Larval stage and young of the year (YOY): Little information is available on the habitat needs of the larval stages of the Redside Dace, and YOY and juvenile Redside Dace have been captured in similar habitats as adults (DFO 2019). YOY have been detected using an intermittent stream for nursery habitat several hundred metres upstream of a known spawning reach (OMNRF, unpubl. data).

Adult: In Ontario, Redside Dace inhabits slow-moving sections of rivers and streams (0.5 to 20 m wide) having a mixture of overhanging stream-side vegetation and pool and riffle habitat (Holm and Crossman 1986; Parker et al. 1988). Pools are used as resident habitat, while riffles are used for spawning. Stream sections flowing through open habitats (meadows, pasture, and shrubs) with overhanging vegetation, undercut banks, and submerged branches and logs, are most suitable. Bottom substrates include boulders, rocks, gravel, or sand, often with a shallow surface covering of detritus or silt (McKee and Parker 1982). Streams are clear or colourless in conjunction with hard substrates, and clear to brown-tinged in streams with organic substrates. Redside Dace prefers clear water and is sensitive to turbidity; however, it has been found in some streams of moderate turbidity (Holm and Crossman 1986). Redside Dace is a cool-water species (COSEWIC 2017) that prefers water temperatures less than 24°C and dissolved oxygen concentrations of at least 7 mg/L (McKee and Parker 1982; Redside Dace Recovery Team 2010; DFO 2019). Research on the thermal tolerance of the species has been conducted on populations in Ohio (Turko et al. 2020) and on the Two Tree River population in Canada (Leclair et al. 2020). Results of the Ohio work indicated that adult Redside Dace are more susceptible to warm water temperatures than juveniles in the summer, that thermal safety margins are narrowest in the summer, and that behavioural agitation occurs ~5°C below the critical thermal maximum (~34°C) for the species (that is, acute upper thermal tolerance) (Turko et al. 2020). Leclair et al. (2020) did not look at juvenile vs. adult tolerance but did confirm that thermal safety margins are narrowest in the summer in an Ontario population.

Foraging strategy/predator avoidance behaviour: The Redside Dace spends most of its time in mixed-species schools in pools at, or near, a mid-depth position in the water column. It seeks protection from predators using submerged woody cover, such as branches and logs (Zimmerman 2009). The Redside Dace relies on visual search of prey at the water’s surface. It is a specialized feeder, its primary food consisting of terrestrial insects, especially adult flies (Schwartz and Norvell 1958; McKee and Parker 1982; Daniels and Wisniewski 1994). The Redside Dace leaps out of the water to obtain such prey. On occasion, it may also feed on aquatic insects and invertebrates. In a study of 2 streams in New York, most of its insect prey were danceflies (*Hilara* spp.) that occur in large swarms over the surface of the water (Daniels and Wisniewski 1994). The Redside Dace will also seek cover under overhanging grasses, forbs, and small shrubs. This streamside vegetation is important, both as a source of cover and as habitat for the insects on which it feeds. Woody debris and low stream velocities are important attributes for overwintering habitat. Feeding strategies of the species under ice are unknown, and food acquisition during this time is likely reduced due to dormancy in cold temperatures.

Supporting habitat: The headwaters[5] of streams are the source of habitat features that perform functions essential to the life history of the species. Headwaters regulate the hydrology of the stream reach occupied by the Redside Dace. It has been estimated that 90% of the flow of a river may originate from the watershed's headwaters (Saunders et al. 2002). These populations directly depend on the functions of these headwater features in supplying suitable baseflow, organic litter for aquatic invertebrates, and coarse sediment for spawning habitat. Accordingly, the protection of contributing headwater wetlands, groundwater seepage areas, and in-stream sediment supply areas is important to sustaining populations that remain nearby, and the protection of headwater systems should be given a high priority in freshwater conservation efforts (Saunders et al. 2002).

The stream meander belt[6] (including riparian vegetation) is an important aspect of a watercourse that supports Redside Dace habitat through its provision of insects, coarse sediment, wood cover, and riparian vegetation. Streams and rivers rarely flow in a consistently straight direction but rather track a serpentine course (meander) consisting of riffles and pools, which can be impacted by both natural and human-induced events. This meandering can lead to lateral adjustments or migrations within the meander belt over time. The integrity of riparian areas helps to maintain riffle-pool morphology characteristics, to filter surface run-off containing fine sediment and nutrients, and to provide bank stability, shade, coarse sediments, cover, and terrestrial insects for food. All of these elements are necessary for the long-term survival of the Redside Dace. For this reason, a minimum of 30 m[7] of vegetated area adjacent to the stream's meander belt is necessary to ensure that healthy riparian habitat is available to provide an important ecosystem function for the Redside Dace. Due to the naturally dynamic nature of riverine systems, and the importance of riparian habitat to highly sensitive stream ecosystems that support the Redside Dace, the 30 m of vegetated area is measured horizontally from the outer boundary of the stream meander belt (figure 4). The inclusion of the meander belt width and associated riparian vegetation recognizes that watercourses move and change over time within the meander belt (OMNRF 2001). Considering that pools, which provide habitat for Redside Dace, are normally found on the outside bends of a meandering stream, the inclusion of the riparian vegetation from the edge of the meander belt ensures that pools are always bordered by riparian vegetation despite their migration over time. Logs, stumps, and fallen branches from the riparian vegetation contribute to overhead cover in the pools, which is necessary for creating hiding places from predation.

In addition, the maintenance of the meander belt serves to reduce the potential for anthropogenic-induced succession (canopy closure) due to channel migration over time. This

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[5] Headwater areas or features are small channels or depressions that directly influence the hydrology, sediment supply, or food supply of flowing streams and rivers.
[6] The meander belt is the land area on either side of a watercourse representing the farthest potential limit of channel migration. Areas within the meander belt may someday be occupied by the watercourse; areas outside of the meander belt will not.
[7] Science-based guidelines developed for guiding habitat rehabilitation in Great Lakes Areas of Concern recommend a minimum of 30 m of naturally vegetated adjacent lands on both sides of the stream (Environment Canada 2004).

may help to ensure diversity of habitat within the belt, including the aspects of the riparian vegetation observed to provide food resources for the Redside Dace such as grasses, forbs, and shrubs, as well as sparse woodlots with rotting wood and meadow areas with flowering plants that may be important to various life stages of terrestrial insect prey.

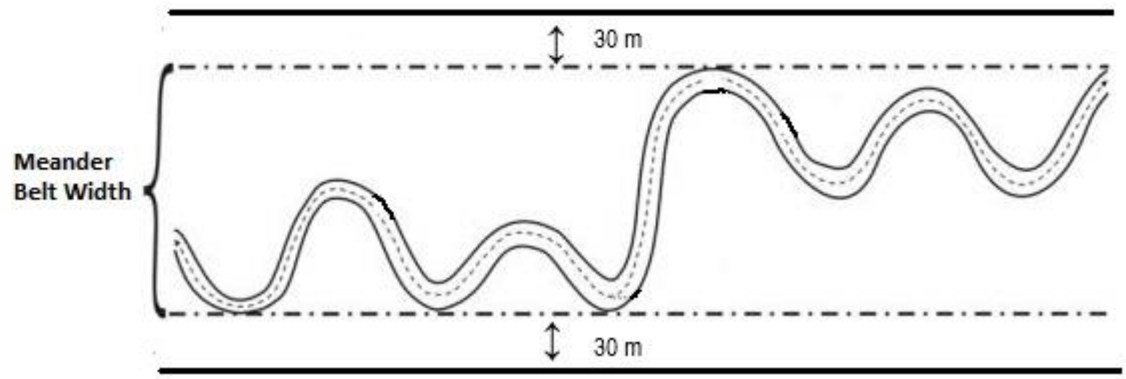

Figure 4. Diagram illustrating meander belt width plus 30 m vegetated area extending from the meander belt width (figure adapted from Parish Geomorphic [2001]).

Limiting factors: Redside Dace spawning is somewhat specialized and may limit its ability to rebound from low population levels. The eggs of the Redside Dace are non-adhesive (Scott and Crossman 1973), possibly making them more susceptible to being washed away from nests by high water velocities (for example, spring floods). The bright yellow and red colour pattern of the Redside Dace may make it more visible to predators, thus affecting survivorship. Its range in several Greater Toronto Area (GTA) watersheds has retracted over several decades, to the remaining small, cool, headwater streams due to urbanization. Urbanization has resulted in water quality impairment and destruction of habitat, which limits widespread dispersal and reduces the propensity for the species to travel to previously occupied stream reaches.

5 Threats

5.1 Threat assessment

Loss of suitable habitat (or habitat modification) is likely the major factor contributing to Redside Dace declines in Ontario (COSEWIC 2017). Populations have been lost from 5 streams that have had major habitat changes associated with intensive urban development and the construction of reservoirs. Population declines associated with habitat loss have likely occurred in about half of Ontario's Redside Dace streams, and only a few are considered to be relatively undisturbed. Pressures on Redside Dace habitats in Ontario are expected to continue to increase, as population growth and associated urban development continue in the "Golden Horseshoe Region", and remain stable or increase in agricultural areas.

Lebrun et al. (2020) assessed 8 threats or potential threats to Redside Dace populations in Canada. Threats to Redside Dace were categorized based on the International Union for Conservation of Nature (IUCN) (IUCN 2014) classification system and ranked following the methods detailed in DFO (2014). Known and suspected threats were ranked with respect to threat likelihood and threat impact for each population, which were then combined to produce threat level assessments at the population and species level (tables 3 and 4). A certainty level was also assigned to the overall threat status, which reflected the level of certainty associated with the threat impact. See Lebrun et al. (2020) for further details. Additional information is provided in the subsequent threat summaries. For more information on threats to Redside Dace, refer to COSEWIC (2017) and DFO (2019).

Table 3. Threat level assessment for Redside Dace populations in Ontario, resulting from an analysis of both the threat likelihood and threat impact. The number in brackets refers to the level of certainty associated with the threat impact (1 = Very high, 2 = High, 3 = Medium, 4 = Low, 5 = Very low) (Lebrun et al. 2020).

Watershed	Residential/ commercial development	Agriculture	Pollution	Natural system modifications	Invasive species	Human intrusion	Biological resource use	Climate change
Pringle Creek	High (2)	Low (3)	Medium (1)	Low (4)	Medium (4)	Low (4)	Low (4)	Unknown
Lynde Creek	High (2)	High (2)	Medium (2)	Medium (2)	Medium (3)	Low (4)	Low (4)	Unknown
Carruthers Creek	High (4)	Low (4)	Low (4)	High (3)	Low (5)	Low (5)	Low (4)	Unknown
Duffins Creek	High (3)	Low (4)	Low (4)	High (3)	Low (5)	Low (5)	Low (4)	Unknown
Petticoat Creek	High (4)	Low (4)	Unknown	Unknown	Unknown	Low (4)	Low (4)	Unknown
Highland Creek	High (2)	Unknown	High (3)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Rouge River	High (2)	Low (3)	Low (4)	High (3)	Low (5)	Low (5)	Low (4)	Unknown
Don River	High (2)	Low (5)	High (3)	High (3)	Low (5)	Low (4)	Low (4)	Unknown
Humber River	High (3)	Low (4)	Low (4)	High (3)	Low (5)	Low (5)	Low (4)	Unknown
Mimico Creek	High (2)	Unknown	High (3)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Etobicoke Creek	High (2)	Unknown	High (3)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Unknown creek in Clarkson	High (2)	Low (3)	High (3)	High (4)	Low (4)	Low (4)	Low (4)	Unknown
Credit River	High (2)	Low (3)	High (3)	Medium (4)	Medium (3)	Low (4)	Low (4)	Unknown
Morrison Creek	High (2)	Low (4)	High (2)	High (3)	Low (4)	Low (4)	Low (4)	Unknown

Watershed	Residential/ commercial development	Agriculture	Pollution	Natural system modifications	Invasive species	Human intrusion	Biological resource use	Climate change
Sixteen Mile Creek	High (2)	Medium (3)	High (2)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Fourteen Mile Creek	High (2)	Low (4)	High (2)	Medium (3)	Low (4)	Low (4)	Low (4)	Unknown
Bronte Creek	Medium (4)	Low (4)	Medium (4)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Wedgewood Creek	High (2)	Low (4)	High (2)	High (3)	Low (4)	Low (4)	Low (4)	Unknown
Spencer Creek	Medium (4)	Unknown	Unknown	Medium (3)	Low (3)	Low (4)	Low (4)	Unknown
Niagara area stream	High (4)	Unknown	Unknown	Unknown	Unknown	Low (4)	Low (4)	Unknown
Holland River	High (4)	Unknown	Unknown	Unknown	Unknown	Low (4)	Low (4)	Unknown
Irvine Creek	Medium (4)	High (4)	Unknown	Unknown	Unknown	Low (4)	Low (4)	Unknown
Gully Creek	Low (3)	High (3)	High (3)	Low (5)	Medium (4)	Low (4)	Low (4)	Unknown
Saugeen River	Low (4)	High (2)	Medium (3)	High (2)	Unknown	Low (4)	Low (4)	Unknown
Unknown Stan J	Low (3)	High (3)	High (3)	Low (5)	Medium (5)	Low (4)	Low (4)	Unknown
Two Tree River	Medium (4)	Unknown	Unknown	Unknown	Unknown	Low (4)	Low (4)	Unknown

Table 4. Species-level threat assessment for Redside Dace in Canada, resulting from a roll-up of population-level threat assessment. Species-level threat risk, threat occurrence (H = Historical, C = Current, A = Anticipatory), threat frequency (S = Single, R = Recurrent, C = Continuous), and threat extent (E = Extensive, B = Broad, R = Restricted). The species-level threat extent is calculated as the mode of population-level threat extent (Lebrun et al. 2020).

Threat	Species-level threat risk	Species-level threat occurrence	Species-level threat frequency	Species-level threat extent
Residential/ commercial development	High (2)	H, C, A	S, R, C	E
Agriculture	High (3)	H, C, A	R, C	B
Pollution	High (3)	H, C, A	R, C	E
Natural system modifications	High (3)	H, C, A	S, R, C	B
Invasive species	Medium (3)	H, C, A	R, C	B
Human intrusion	Low (4)	H, C, A	R	R
Biological resource use	Low (4)	H, C, A	R	R
Climate change	Unknown	A	C	E

5.2 Description of threats

The following brief descriptions emphasize the principal threats currently acting on Redside Dace populations throughout Ontario.

Residential and commercial development (1.1 Housing and urban areas, 1.2 Commercial and industrial areas)[8]

Given that more than 80% of Canada's Redside Dace populations are found in the "Golden Horseshoe Region" of Ontario, construction and stormwater associated with urban development represent the most immediate threats to the species in Canada. Several populations have been lost or remain only in headwater areas. Many of the remaining populations are found in areas currently scheduled for urban development or areas where development could occur. The human population of the Golden Horseshoe Region is expected to increase by almost 13.5 million people by 2041 (Ministry of Public Infrastructure Renewal 2004; Ministry of Municipal Affairs and Housing 2016). Currently, some of the healthiest remaining populations of Redside Dace are bordered by urban development, but are found in subwatersheds that are relatively undisturbed.

Reductions in Redside Dace populations have coincided with areas of urban development in southern Ontario. Environmental impacts often associated with urban development are generally thought to be responsible for changes in Redside Dace habitats and, thus, the populations. Impacts from urban development include increases in imperviousness of the watershed, producing highly erosive stream-flow conditions; alterations to groundwater discharge areas; unsatisfactory erosion and sediment control during construction that results in impaired water clarity, thereby affecting Redside Dace feeding success; and, increases in water temperature from urban stormwater run-off. Dramatic changes in a watershed's imperviousness severely influence stream hydrology (flow regime), resulting in negative changes to in-channel structure (for example, dimensions of riffles, pools, bankfull width). This is referred to as urban stream syndrome. Several studies have shown that the quality of streams and their biota can be negatively affected when impervious cover (for example, roads, houses, parking lots) exceeds 10% of a stream's catchment area (Booth and Jackson 1997; Environment Canada 2004; Stanfield et al. 2004). Environment Canada (2004) recommends maintaining urbanized watersheds at less than 10% imperviousness to maintain stream water quality and quantity, and to preserve aquatic species density and biodiversity. A study of streams in the Lake Ontario basin (Stanfield et al. 2004) demonstrated that native salmonid species only occurred in streams with a catchment that was less than 10% impervious cover. While such detailed landscape-based analysis has not yet been conducted specifically for Redside Dace habitats in Ontario, a preliminary analysis by Parish (2004) also found that Redside Dace prefers stream channels that are not heavily influenced by urban drainage. Reid and Parna (2017) found that streams with healthy Redside Dace populations had greater contributions of groundwater and more stable stream-flow conditions in comparison to unstable streams with extirpated populations. Further study is required to identify appropriate techniques to mitigate the influence of impervious cover in watersheds, to maintain healthy Redside Dace populations.

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[8] Information in parentheses within the threat headings in section 5.2 refers to the IUCN threats calculator heading (see COSEWIC 2017 for more information). Note that not all threats listed in a threat heading may be applicable to Redside Dace.

Direct changes to channel structure through channelization that often occurs in urban areas would have similar effects. Removal of riparian vegetation would directly affect the production of terrestrial insects required by Redside Dace during a large portion of the year (Reid et al. 2019). Riparian vegetation is also an important source of cover in the small streams inhabited by Redside Dace. A rise in stream temperature is often associated with clearing of stream-bank vegetation. Urban stormwater, having been significantly warmed by being in contact with rooftop and asphalt surfaces, poses a particular problem for Redside Dace in some streams, owing to its preference for cool water habitats. Other developments may contribute to diversions, reductions, or dramatic increases in ground water inputs, which are important in regulating summer temperatures and base flows in streams.

Agricultural and aquaculture (2.1 Annual and perennial non-timber crops, 2.3 Livestock farming and ranching)[8]

Despite the fact that urban development is the primary factor affecting Redside Dace populations in Canada, declines in Redside Dace distribution and abundance have also been observed in agricultural settings (for example, Saugeen River and Irvine Creek). While low intensity operations (for example, hayfields) may not pose a problem, intensive agriculture (for example, row cropping and intensive grazing), stream straightening, and drain maintenance present several threats to Redside Dace populations.

Some of the factors associated with agricultural practices that may affect Redside Dace are similar to those found in urban settings; however, specific mechanisms are poorly understood. Removal of riparian vegetation to increase crop production or allowing livestock access to streams can contribute to siltation and changes in channel structure. Some streams have been straightened, channelized, and/or converted to municipal drains in the past. The extensive use of tile drains also increases flows after storm events and can serve as a conduit for sediment and pollutants. Agricultural landscapes also provide the opportunity for episodic or chronic pollution events associated with the use of pesticides, livestock manure spills, and fertilizers. Specific mechanisms affecting Redside Dace in agricultural settings have not been evaluated through scientific study.

Pollution (9.1 Domestic and urban wastewater, 9.3 Agricultural and forestry effluents)[8]

The specific impacts of pollution on Redside Dace are not known. Populations may be at risk of exposure to chemicals, as a result of urban development (for example, household chemicals, contaminated stormwater run-off). Elevated levels of chlorides, nutrients, bacteria, and metals were found in 2 Credit River tributaries, Fletcher and Silver creeks, where Redside Dace has declined, seemingly as a result of an increase in urban run-off (Credit Valley Conservation 2002). Additionally, the use of fertilizers, pesticides, and herbicides may lead to acute or chronic exposure to pollution for Redside Dace populations in rural areas (COSEWIC 2017). A manure spill in Irvine Creek killed all fishes found along several kilometres of stream (COSEWIC 2007), and in 2007, a liquid nitrogen spill resulted in a fish kill, including dozens of Redside Dace, along 10 km of the Little Rouge River (Ministry of Environment Conservation and Parks 2008; D.

[8] Information in parentheses within the threat headings in section 5.2 refers to the IUCN threats calculator heading (see COSEWIC 2017 for more information). Note that not all threats listed in a threat heading may be applicable to Redside Dace.

Lawrie, Toronto and Region Conservation Authority [TRCA], pers. comm. 2020). More recently, a manure spill in 2014 in Lynde Creek where Redside Dace has been observed, killed most fishes in a 21 km stretch. Although Redside Dace was not observed among the dead specimens, it has not been captured in the area since the spill (sampling occurred in 2014, 2016, and 2017) (COSEWIC 2017).

Natural system modifications (7.2 Dams and water management/use, 7.3 Other ecosystem modifications)[8]

In Ontario, Redside Dace appears to achieve highest abundance in open streams with riparian vegetation consisting of grasses, forbs, and low shrubs (Reid et al. 2019). These habitats may be maintained by the presence of wetlands, spring flooding, channel migration, beaver activity, and, historically, wild fires. Treed areas with complete canopy closure may not provide optimal habitat. Induced succession to tree species and canopy closure, as a result of tree planting projects in meadow-type riparian habitat, may similarly reduce the quality of Redside Dace habitat through the loss of grass and shrub species (for example, Andersen 2002; Redside Dace Recovery Team 2010).

Activities associated with the extraction of aggregates may result in reduced base flows and increased stream temperatures (OMNRF 2001). Similarly, withdrawals of surface water and ground water for crop irrigation in watersheds with Redside Dace populations may reduce flows to unacceptable levels and result in increased stream temperatures. The impacts of such extraction and withdrawal activities on Redside Dace populations have not been specifically investigated but are expected to be negative.

Although the Redside Dace can leap several centimetres out of the water to catch flying insects (COSEWIC 2017), it cannot leap over vertical barriers such as dams, low-head weirs, and perched culverts; therefore, habitat fragmentation is likely an issue in streams containing such structures. Habitat fragmentation can alter habitat conditions, resulting in restricted movements of individual fish and limited gene flow between populations. Furthermore, habitat fragmentation may limit the ability of Redside Dace populations to recruit back to historically occupied reaches, even if restoration efforts have adequately restored habitat conditions. However, in some locations, vertical barriers (or fisheries partitions) also prevent the movement of invasive species (that is, non-indigenous species that pose ecological, economic, or social harm), as well as non-indigenous species (that is, species found outside its normal distribution within a watershed that may or may not pose harm or have an impact on the ecosystem) that could be detrimental to Redside Dace, into streams occupied by Redside Dace. There are 15 known structures acting as partitions across the range of the species in Ontario; refer to appendix D to see a list of fisheries partitions important for Redside Dace.

Genetic diversity may be an important conservation issue for Redside Dace in Ontario (and elsewhere), as most populations are small and isolated. Many potential pathways of genetic interchange have been lost through the reduction in population connectivity and habitat, or the construction of vertical barriers. Population genetic structure of the Redside Dace has been described based on an analysis of variation of mitochondrial DNA and microsatellite loci across

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28 populations in Ontario and the United States (U.S.); results indicated that populations are unique at a local level, as well as regional level, likely as a result of small population effects rather than local adaptation (Serrao et al. 2017a).

Invasive and other problematic species, genes, and diseases (8.1 Invasive Non-native/alien species/disease)[8]

The impacts of introduced species (that is, non-indigenous species that are deliberately introduced to a watershed and that may or may not pose harm or have an impact on the ecosystem) on the Redside Dace have not been specifically studied, but declines in Redside Dace populations have been observed in Spencer Creek, concomitant with the introduction of Golden Shiner (*Notemigonus crysoleucas*) (S. Staton, DFO, pers. comm. 2020) and predatory Northern Pike (*Esox lucius*) (Holm 1999). Declines in Redside Dace populations in the Bronte Creek watershed occurred after introductions of Black Crappie (*Pomoxis nigromaculatus*), Largemouth Bass (*Micropterus salmoides*), and Northern Pike to a reservoir in the upper portion of the watershed (D. Featherstone, Nottawasaga Valley Conservation Authority, pers. comm. 2009); multiple smaller impoundments built by landowners on various Bronte Creek tributaries also provide habitat for introduced species and are believed to have contributed to the broader decline of Redside Dace in the system (S. Mason, Conservation Halton, pers. comm. 2020). A definitive understanding of the implication of species introductions on Redside Dace has been difficult due to other co-occurring threats ongoing in these systems. Although Greeley (1938) reported that Redside Dace competes with trout for food, the interactions between Redside Dace and salmonids have not been specifically studied. Non-native, resident Brown Trout (*Salmo trutta*) and migratory Rainbow Trout (*Oncorhynchus mykiss*) have been introduced into several Toronto-area streams with Redside Dace populations present. Redside Dace is known to naturally co-exist with native Brook Trout (*Salvelinus fontinalis*) in several Toronto area streams. Lyons et al. (2000) noted that Redside Dace disappeared from 2 Wisconsin streams after the introduction of Brown Trout, but no cause-and-effect relationship was established. Brown Trout is known to have negative impacts on native Brook Trout and is considered an invasive species in some jurisdictions (Global Invasive Species Database 2020). Resident Brown Trout are highly likely to directly prey on Redside Dace, as they do with native Brook Trout. A large number of Redside Dace were found in the stomach of a Brown Trout (A. Drake, pers. comm. 2022). An experimental examination of the interactions between Rainbow Trout and the closely related Rosyside Dace (*C. funduloides*) suggested that interactions between the 2 species were minimal (Rincon and Grossman 1998). However, further research is required to assess the potential threat of juvenile and adult non-native migratory Rainbow Trout on Redside Dace. Redside Dace may be more susceptible to the impacts of introduced species when stream systems are affected by multiple stresses (COSEWIC 2017).

Since its introduction to the great lakes basin, the Round Goby (*Neogobius melanostomus*) has been implicated in the declines of a variety of native fish species (for example, Thomas and Haas 2004). The species has been moving inland and has become established in Redside Dace habitats (for example, Round Goby is moving into some of the highest abundance habitats for Redside Dace in Berczy Creek [D. Lawrie, TRCA, pers. comm. 2024]). Although there are no

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studies on Round Goby/Redside Dace interactions, potential impacts of Round Goby on the fish community and on Redside Dace are of concern.

Invasive plants such as Common (European) Buckthorn (*Rhamnus cathartica*) and Norway Maple (*Acer platanoides*) are replacing native tree/plant species within the riparian vegetation in some locations, leading to a lack of species diversity and preventing understory vegetation from growing, which can result in increasing stream bank erosion (D. Forder, Ontario Streams, pers. comm. 2020). Further research on the impacts of invasive plants on Redside Dace habitat in Ontario is required.

Human intrusion and disturbance (6.3 Works and other activities)[8]

While it is unlikely that scientific monitoring work has had a major impact on Redside Dace populations in Ontario, incidental mortality as a result of sampling should be viewed as a potential threat. This is particularly true for populations that currently occupy a reduced area of stream and may be restricted to a small number of pools (Redside Dace Recovery Team 2010; COSEWIC 2017). A study conducted by Reid and Lebaron (2021) looking at sampling best practices for Redside Dace found that the median rate of sampling-related mortality for all fishes was 1.7% for summer electrofishing, 0.3% for fall electrofishing, and 3.8% for summer seining. Summer electrofishing-related mortalities were generally Blacknose Dace (*Rhinichthys atratulus*), Johnny Darter (*Etheostoma nigrum*), Longnose Dace (*R. cataractae*), Mottled Sculpin (*Cottus bairdii*), or Rainbow Darter (*E. caeruleum*). Fall electrofishing-related mortalities were predominately Longnose Dace, Rainbow Darter, and Rainbow Trout. Seining-related mortalities largely consisted of YOY leuciscids and Common Shiner. YOY mortalities were likely a result of using a seine with small mesh size. No Redside Dace mortalities were observed. Another study comparing the use of underwater cameras to conventional sampling gear (backpack electrofishing and seining) to detect Redside Dace found that backpack electrofishing had a mortality rate of 5.8%, while seining had a rate of 0.5% (use of cameras resulted in no mortalities) (Castañeda et al. 2020). The indirect impacts of non-lethal sampling (electrofishing, seining) have not been studied.

Biological resource use (5.4 Fishing and harvesting aquatic resources)[8]

Redside Dace is not a legal baitfish in Ontario (OMNRF 2019), but there is potential for incidental harvest by commercial and recreational harvesters. Bycatch from the commercial industry has been estimated by Drake and Mandrak (2014b). Bycatch-effort relationships were estimated based on species-specific catchability and the co-occurrence of target and non-target species at stream crossings. Given a harvest strategy where each road crossing had an equal probability of harvest, the model indicated that an average of 358 harvest events would be required for a single event to have a median 95% chance of Redside Dace bycatch. Model uncertainty suggested that effort could be lower (156 harvest events), or higher, with the possibility of not reaching a 95% chance of bycatch, regardless of effort (Drake and Mandrak 2014b). In contrast, only 17 events were required to reach the 95% threshold for species that

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[8] Information in parentheses within the threat headings in section 5.2 refers to the IUCN threats calculator heading (see COSEWIC 2017 for more information). Note that not all threats listed in a threat heading may be applicable to Redside Dace.

were predicted to be frequently caught as bycatch (for example, Rock Bass [*Ambloplites rupestris*], Pumpkinseed [*Lepomis gibbosus*]) (Drake and Mandrak 2014b).

Given the rarity of Redside Dace, it would seem that the potential for incidental harvest is low. However, should bycatch occur, the ability of harvesters to identify and remove the species is unknown. A study examining the Ontario baitfish pathway did not document any Redside Dace from baitfish purchases or holding tanks in southern Ontario in August to October 2007 and February 2008 (Drake and Mandrak 2014a). This suggests that either the species was sorted and removed from catches, or bycatch did not occur at all. Finally, all commercial baitfish harvesters have conditions on their OMNRF-issued licences prohibiting harvest in Redside Dace streams during the spawning season.

Climate change and severe weather (11.1 Habitat shifting and alteration)[8]

Global climate change effects on Redside Dace populations are difficult to forecast; however, impacts such as decreases in stream base flows, increases in water and air temperatures, increases in the frequency of extreme weather and flooding events, emergence of diseases, shortening of the duration of ice cover, and shifts in predator-prey dynamics have been highlighted, all of which may negatively impact native fishes such as the Redside Dace (Lemmen and Warren 2004). Of these, potential decreases in stream baseflow, increases in water temperatures, and increased flooding events are expected to be the most detrimental to populations of Redside Dace. Although climate change may make conditions more suitable for Redside Dace in more northern portions of the province, the potential for colonizing new areas is low.

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[8] Information in parentheses within the threat headings in section 5.2 refers to the IUCN threats calculator heading (see COSEWIC 2017 for more information). Note that not all threats listed in a threat heading may be applicable to Redside Dace.

6 Population and distribution objectives

Long-term population objective: To ensure that all populations/sub-populations (both extant and historical) within the 17 watersheds listed below demonstrate signs of reproduction and recruitment, and are stable or increasing with low risk[9] from known threats. Note that the inclusion of historical populations within this objective is limited only to locations where feasible and warranted[10].

Long-term distribution objective: To ensure the survival of self-sustaining populations/sub-populations within currently and, where feasible and warranted, historically occupied reaches in the following watersheds:

1. Lynde Creek
2. Carruthers Creek
3. Duffins Creek
4. Rouge River
5. Don River
6. Humber River
7. Credit River
8. Sixteen Mile Creek
9. Fourteen Mile Creek
10. Bronte Creek
11. Spencer Creek
12. Holland River
13. Irvine Creek
14. Gully Creek
15. Saugeen River
16. Unknown Stan J
17. Two Tree River

The populations/sub-populations within these 17 watersheds could be considered recovered when they demonstrate signs of reproduction and recruitment throughout their distribution in each watershed, such that populations are self-sustaining and stable or increasing. This recovery would include the re-establishment of populations within currently unoccupied tributaries and stream reaches where connectivity to occupied reaches remains, as well as the maintenance and enhancement of populations within occupied reaches. Where feasible, recovery may also include the re-establishment of populations in historically occupied reaches that are not connected to currently occupied habitat. The locations of these habitats within the 17 watersheds have been identified within the critical habitat section (section 8) (figures 5 to 18). Within the 9 watersheds where Redside Dace is thought to be extirpated (that is, unknown creek in Clarkson, Etobicoke Creek, Highland Creek, Mimico Creek, Morrison Creek, Niagara area stream, Petticoat Creek, Pringle Creek, and Wedgewood Creek) the over-riding effects of

[9] It is recognized that it may not be possible to reduce all threats at all locations to a low level.
[10] Further surveys may determine that the species is still extant (that is, present) at sites that are believed to be extirpated (that is, historical). In addition, as the “schedule of studies” is completed to better refine the population and distribution objectives, populations at some historical reaches may be excluded and/or deemed not feasible to recover.

widespread urbanization are considered to be essentially irreversible. Therefore, these watersheds have not been included within the population and distribution objectives for the species; however, this can be re-considered should new information become available (for example, evidence that the species exists at 1 or more of these watersheds).

Rationale: Knowledge of population demographics (extent, abundance, trajectories, and targets) is currently limited and remaining populations are small. Recent modelling conducted by van der Lee et al. (2019) estimated the minimum viable population size (MVP) for Redside Dace under various catastrophe scenarios: 1) a single population model, 2) a meta-population model with linked catastrophes, 3) a meta-population model with 1 rescue sub-population, and 4) a meta-population model with independent catastrophes. Conservative MVP values[11] ranged from approximately 18,000 to 75,000 adults, depending on the catastrophe scenario (mentioned above). It must be noted that these numbers are representative of any Ontario population of Redside Dace; population-specific targets would require population-specific life-history data. The implementation of such targets is difficult without also having information on population demographics, spatial distribution, and habitat quality, and a more complete understanding of the life history of the species. van der Lee et al. (2019) also determined that Redside Dace populations are particularly sensitive to activities that affect the survival of immature individuals (from hatch to age 2) and population-level fecundity, but that recovery efforts affecting survival of all life stages would provide the greatest improvement to population growth rate, resulting in the quickest recovery (48 years). For further information on the recovery potential modelling for Redside Dace, refer to van der Lee et al. (2019).

It is important to note that the setting of population and distribution objectives and the identification of critical habitat are science-based exercises and that socio-economic factors were not considered in their development.

7 Broad strategies and general approaches to meet objectives

7.1 Actions already completed or currently underway

A number of recovery-related projects have been conducted to assess the quality of Redside Dace habitat and identification of important habitat features, the status and extent of subpopulations, the effect of land-use practices on instream habitat, the dispersal behaviour of the Redside Dace as it pertains to habitat quality, and ecosystem and watershed-based recovery programs that would benefit the Redside Dace. Refer to appendix C for a detailed list of actions that have been completed or that are underway for Redside Dace since 2010. For a similar list of recovery activities conducted prior to 2010, refer to the provincial "Recovery Strategy for the Redside Dace (*Clinostomus elongatus*) in Ontario" (Redside Dace Recovery Team 2010).

[11] Using a quasi-extinction threshold of 50 adults, given a 15% chance of a catastrophic event occurring per generation, and an extinction probability of 1% over 100 years.

7.2 Measures to be taken to implement the recovery strategy and action plan

Successful recovery of this species is dependent on the actions of many different jurisdictions. It requires the commitment and cooperation of the constituencies that will be involved in implementing the directions and measures set out in this recovery strategy and action plan. This recovery strategy and action plan provides a description of the measures that provide the best chance of achieving the population and distribution objectives for Redside Dace, including measures to be taken to address threats to the species and to monitor its recovery, to guide not only activities to be undertaken by DFO, but those for which other jurisdictions, organizations, and individuals have a role to play. Four broad strategies were recommended to address threats to the species and meet the population and distribution objectives: 1) Inventory and Monitoring, 2) Research, 3) Management and Coordination, and 4) Stewardship and Outreach. These approaches or activities are further divided into numbered recovery measures with a priority ranking (high, medium, low), identification of the threat addressed, and associated timeline (tables 5 and 6). As new information becomes available, these measures and the priority of these measures may change. DFO strongly encourages all Canadians to participate in the conservation of Redside Dace by undertaking measures outlined in this recovery strategy and action plan.

Table 5 identifies the measures to be undertaken by DFO to support the recovery of Redside Dace. Table 6 identifies the measures to be undertaken collaboratively between DFO and its partners, other agencies, organizations or individuals. Implementation of these measures will be dependent on a collaborative approach, in which DFO is a partner in recovery efforts, but cannot implement the measures alone. As all Canadians are invited to join in supporting and implementing this recovery strategy and action plan, table 7 identifies the measures that represent opportunities for other jurisdictions, organizations or individuals. If your organization is interested in participating in any of these measures, please contact the Species at Risk-Ontario and Prairie office.

Federal funding programs for species at risk that may provide opportunities to obtain funding to carry out some of the outlined activities include the Habitat Stewardship Program for Aquatic Species at Risk, Aboriginal Fund for Species at Risk, and the Canada Nature Fund for Aquatic Species at Risk.

The measures included in this recovery strategy and action plan to be implemented by DFO will be subject to the availability of funding and other required resources. As indicated in the tables below, partnerships with specific organizations will provide expertise and capacity to carry out some of the listed recovery measures. Some of the partnerships for recovery measures have been established with member organizations of the Redside Dace Recovery Implementation Team. However, the identification of partners is intended to be suggestions to other jurisdictions and organizations, and carrying out these actions will be subject to each group’s priorities and budgetary constraints.

Redside Dace populations are found throughout the traditional territories of many Indigenous peoples. Indigenous peoples have a unique, complex relationship alongside constitutionally protected Rights to species that extend beyond using those species for their personal or community needs or as a life-support system. Indigenous relationships to various species include cultural, spiritual, economic, stewardship, governance and Rights-based aspects. Many Indigenous Nations indicate they have responsibilities given to those species by the Creator to provide for people and nature. Ensuring that these relationships can continue is critical to their future. Organizations carrying out recovery measures for the species should engage with relevant Indigenous Nations communities on their activities, and consult if/when necessary.

Table 5. Measures to be undertaken by Fisheries and Oceans Canada for the Redside Dace.

#	Recovery measures	Approach	Broad strategy	Priority[12]	Threats or concern addressed	Status/ timeline[13]
1	Work with municipal planning authorities such that they consider the protection of critical habitat for Redside Dace within municipal planning documents (for example, Official Plans, Secondary Plans, Subwatershed Management Plans, Block Plans, and Stormwater Management Plans). This measure will provide additional urban stormwater impact mitigation for Redside Dace when development proposals are planned and reviewed.	Habitat protection – planning	Management and coordination	High	Residential/ commercial development	Underway/ ongoing
2	Ensure that the potential invasion of aquatic invasive species and non-indigenous species into Redside Dace waters is considered during project reviews by Fisheries and Oceans Canada (DFO) when removal of barriers is contemplated. This measure will reduce potential negative impact of these species on Redside Dace.	Threat evaluation – species introductions (barrier removal)	Management and coordination	Medium	Invasive species	Underway/ ongoing

[12] "Priority" reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the recovery of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the recovery of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

[13] Timeline reflects the amount of time required for the measure to be completed from the time the recovery strategy and action plan is published as final on the Species at Risk Public Registry.

Table 6. Measures to be undertaken collaboratively between Fisheries and Oceans Canada and its partners for the Redside Dace.

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
3	Maintain Redside Dace distribution database to identify critical habitat and coordinate with appropriate planning authorities and the Natural Heritage Information Centre to ensure the comparability of map data among organizations. This measure will provide current information on the distribution of Redside Dace for the protection of habitat during the planning and review of proposals for development and work in, or adjacent to, streams where Redside Dace is present.	Habitat protection – distribution data	Management and coordination	High	All threats	Underway/ ongoing	Fisheries and Oceans Canada (DFO); Ontario Ministry of Environment, Conservation and Parks (OMECP); Ontario Ministry Natural Resources and Forestry (OMNRF); Parks Canada (PC); Indigenous Nations; conservation authorities[16]; academia; environmental non-governmental organizations (ENGOs); consultants/industry
4	Work with drainage superintendents, drainage engineers, and contractors, to avoid, minimize, or eliminate the	Habitat protection – drainage	Management and coordination	Medium	Agriculture	Underway/ ongoing	DFO, OMECP, OMNRF, Ontario Ministry of Agriculture (OMAFRA), conservation authorities

[14] “Priority” reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the recovery of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the recovery of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

[15] Timeline reflects the amount of time required for the measure to be completed from the time the recovery strategy and action plan is published as final on the Species at Risk Public Registry.

[16] Conservation authorities (CA) may include one or more of the following organizations that cover watersheds where Redside Dace currently occurs: Saugeen Valley CA, Ausable Bayfield CA, Grand River CA, Hamilton CA, Conservation Halton, Credit Valley CA, Toronto and Region CA, Central Lake Ontario CA, and Lake Simcoe Region CA.

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
	effects of any new or maintenance-related drainage works in Redside Dace habitat. This measure will protect Redside Dace habitat that may be impacted by drain maintenance activities.						
5	Review existing fisheries partitions and identify candidate partitions within the range of Redside Dace. This measure will allow for the protection of Redside Dace populations from potential invasions of aquatic invasive species and non-indigenous species.	Threat evaluation – aquatic invasive species	Management and coordination	Medium	Invasive species	New/5 years	OMNRF, OMECP, DFO, Indigenous Nations, conservation authorities, ENGOs
6	Continue to coordinate with OMNRF, OMECP, and conservation authorities to establish a standard Redside Dace monitoring program to assess presence/absence through time in streams throughout the species' Ontario range. This program will provide an ongoing assessment of occupied range in Ontario, including population and habitat assessments. Establish a monitoring program using a standardized sampling protocol to assess temporal changes in population abundance and habitat conditions resulting from human activities. This measure will allow for an assessment of the efficacy of restorative actions and the condition of Redside Dace populations and habitats at specific sites. A two-tiered sampling approach may be	Assessment – monitoring program	Inventory and monitoring	High	Knowledge gaps	Underway/ ongoing	DFO, OMNRF, OMECP, PC, Indigenous Nations, conservation authorities, ENGOs

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
	prescribed, including both low-effort and labour-intensive methods. The more labour-intensive measures, such as density estimates, could be applied to smaller spatial scales for research, such as habitat associations. In contrast, less intensive presence/absence data could be collected over larger spatial scales to assess the distributional extent of populations within watersheds.						
7	Evaluate health of all Redside Dace stream corridors, as well as supporting habitat, by watershed, and investigate the feasibility of restoring stream water quality, riparian vegetation, headwater features and hydrologic functions. This measure will allow for the identification of priorities for rehabilitation projects.	Assessment – habitat quality	Inventory and monitoring	Low	All threats, excepting invasive species, human intrusion, and biological resource use	New/ 5 years	DFO, OMNRF, PC, ENGOs, conservation authorities, academia
8	Examine global and local variation in genetic diversity of Redside Dace populations through DNA and microsatellite analysis. This measure will provide information regarding effects of fragmentation and inbreeding depression, and the importance of source strains for re-introductions. Examine local adaptations and variation in functional genes related to the expression of important biological traits such as thermal tolerance or colouration. Employ eDNA, followed	Assessment – genetics	Research	Low	Knowledge gaps	Underway/ 5 years	OMNRF, OMECP, DFO, conservation authorities, academia

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
	by traditional sampling methods, to detect and confirm, respectively, the presence of Redside Dace within stream reaches.						
9	Investigate the impacts of species that have been introduced into Redside Dace streams (non-native salmonids, centrarchids, Northern Pike, other leuciscids). This measure will allow for the protection and recovery of populations from harmful impacts of introductions.	Threat evaluation – introduced species	Research	Medium	Invasive species	New/ 7 years	OMNRF, DFO, conservation authorities, academia
10	Identify key factors associated with urban development and agricultural practices that contribute to declines in Redside Dace populations. Investigate effective mitigation of these factors on Redside Dace population dynamics as well as the impact of water-taking and urban stormwater. This measure will lead to improved ability to both protect and rehabilitate Redside Dace habitat through urban planning, infrastructure retrofits, and the improvement of best management practices in both urban and agricultural environments.	Threat evaluation – urban and agricultural impacts	Research	Medium	Residential/ commercial development and agriculture	New/ 5 years	OMNRF, OMAFRA, DFO, conservation authorities, municipalities, academia
11	Investigate the feasibility of artificial propagation versus wild fish transfers for Redside Dace re-introductions. This measure will provide guidance on when and how re-introduction should be considered, on alternatives for Redside Dace re-introductions, and	Re-introductions – artificial rearing and translocations	Research	High	All threats	Underway/ 7 years	OMNRF, OMECP, DFO, ENGOs, Indigenous Nations, conservation authorities, academia

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
	potentially on a refuge for endangered native populations.						
12	Identify candidate streams for re-establishing Redside Dace through a feasibility analysis. Re-introductions should be restricted to areas of former occurrence where suitable habitat occurs or has been restored and where no obvious impediments to re-establishment exist. Donor populations should be sourced from locations with healthy populations as close as possible to the recipient stream, given the genetic differences at the regional and local scale. These actions will increase the number and range of Redside Dace occurrences.	Re-introductions – candidate locations	Research	High	All threats	New/ 10 years	OMNRF, DFO, Indigenous Nations, ENGOs, conservation authorities, academia
13	Continue to develop a Redside Dace awareness plan to guide awareness efforts in urban and rural areas. The plan will identify audiences, develop conservation messages, and encourage media support to deliver the awareness program.	Awareness – strategy	Stewardship and outreach	Low	All threats	Underway/ 5 years	OMNRF, DFO, Toronto Zoo, Ontario Streams, conservation authorities, academia
14	Foster public support and awareness by developing appropriate materials and programs identified in the awareness plan. This measure will improve understanding of conservation messages within the general public, Indigenous Nations, landowners, urban development industry, municipalities, and other	Awareness – outreach	Stewardship and outreach	High	All threats	Underway/ ongoing	OMNRF, DFO, conservation authorities, Toronto Zoo, academia, ENGOs

#	Recovery measures	Approach	Broad strategy	Priority[14]	Threats or concern addressed	Status/ timeline[15]	Potential partners
	stakeholders, and stimulate community support for recovery efforts.						

Table 7. Measures that represent opportunities for other jurisdictions, organizations or individuals to lead for the Redside Dace.

#	Recovery measures	Approach	Broad strategy	Priority[17]	Threats or concern addressed	Potential/confirmed jurisdictions or organizations
15	Secure lands that support healthy populations of Redside Dace. Species conservation reserves with healthy populations can serve as a source for re-introductions elsewhere, providing genetic rescue to small populations.	Habitat protection – securement	Management and coordination	High	All threats excepting human intrusion and biological resource use	Indigenous Nations, municipalities, private landowners, environmental non-governmental organizations (ENGOs), conservation authorities
16	Work with planning authorities to ensure that geographically appropriate management plans are completed for areas where development is forecasted within Redside Dace subwatersheds. Plans should incorporate the guidelines for development in Redside Dace habitat. This measure will provide additional protection for Redside Dace when	Habitat protection – planning	Management and coordination	High	All threats, excepting invasive species, human intrusion, and biological resource use	Ontario Ministry of Environment, Conservation and Parks (OMECP), municipalities, conservation authorities

[17] "Priority" reflects the degree to which the measure contributes directly to the recovery of the species or is an essential precursor to a measure that contributes to the recovery of the species:

- "high" priority measures are considered likely to have an immediate and/or direct influence on the recovery of the species
- "medium" priority measures are important but considered to have an indirect or less immediate influence on the recovery of the species
- "low" priority measures are considered important contributions to the knowledge base about the species and mitigation of threats

#	Recovery measures	Approach	Broad strategy	Priority[17]	Threats or concern addressed	Potential/confirmed jurisdictions or organizations
	development proposals are planned and reviewed.					
17	Continue to educate and work with licenced baitfish harvesters to help reduce the possibility of incidental harvest of Redside Dace.	Threat evaluation – harvest management (baitfish)	Management and coordination	Low	Biological resource use	Ontario Ministry of Natural Resources and Forestry (OMNRF)
18	Review locations where intentional introductions of non-indigenous species have established or are proposed to occur in Redside Dace habitat, and consider stocking in alternative locations. In locations with established populations of non-indigenous species, consider methods to reduce potential impacts on Redside Dace.	Threat evaluation – intentional fish introductions	Management and coordination	Medium	Invasive species	OMNRF
19	Continue/complete riparian rehabilitation, water quality monitoring, stormwater management retrofits, and in-stream works on existing rehabilitation projects, and initiate rehabilitation projects on top priority streams. This measure will improve Redside Dace habitat in streams where its abundance/range has been reduced, allowing for population growth, recolonization, or re-introduction. All rehabilitation efforts should include an evaluation component to assess effectiveness.	Habitat improvement – rehabilitation	Management and coordination	High	All threats, excepting invasive species, human intrusion, and biological resource use	Indigenous Nations, Parks Canada (PC), conservation authorities, ENGOs, private landowners, municipalities
20	Encourage the use of best management practices (BMPs) in rural streams to restore healthy riparian vegetation, reduce livestock access, establish manure storage and run-off collection systems, encourage conservation tillage, and reduce the impact of tile drains.	Habitat improvement – BMPs	Management and coordination	High	Agriculture	PC, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), conservation authorities, ENGOs, private landowners

#	Recovery measures	Approach	Broad strategy	Priority[17]	Threats or concern addressed	Potential/confirmed jurisdictions or organizations
	Riparian rehabilitation should focus on the re-establishment of grasses and shrubs. These BMPs will improve Redside Dace habitat by reducing agricultural run-off and bank erosion, thereby limiting the input of sediments and nutrients from agricultural lands.					
21	Encourage development of Environmental Farm Plans and Nutrient Management Plans where these are not required by law. This measure will provide for additional habitat protection and improvement in relation to farming practices.	Habitat improvement – farm planning	Management and coordination	High	Agriculture	PC, OMAFRA, conservation authorities, ENGOs, private landowners
22	Conduct detailed fluvial geomorphological and hydrological assessments of urbanized and rural Redside Dace streams (good sites versus poor sites) as per recommendations of Parish (2004). This measure will describe Redside Dace habitat with regard to channel form and flow necessary from a geomorphic perspective, to refine species-specific stream restoration and urban development guidelines, and contribute to the design of habitat for restoration projects.	Habitat requirements – fluvial geomorphology	Research	Low	All threats, excepting invasive species, human intrusion, and biological resource use, knowledge gaps	OMNRF, conservation authorities, academia
23	Make landowners aware of existing incentive programs for conservation lands (for example, Habitat Stewardship Program for Aquatic Species at Risk, Aboriginal Fund for Species at Risk, Conservation Land Tax Incentive Program). These incentives will increase	Habitat protection – incentives	Stewardship and outreach	Low	All threats, excepting invasive species, human intrusion, and biological resource use	Conservation authorities, ENGOs

#	Recovery measures	Approach	Broad strategy	Priority[17]	Threats or concern addressed	Potential/confirmed jurisdictions or organizations
	the number of landowners participating in incentive programs that protect habitat.					

7.3 Narrative to support the implementation tables

Selected recovery measures are explained further in this section where additional context, history, or information was deemed useful for interpretation. The inclusion of a narrative is not meant to imply a measure is of higher priority, nor is it meant to suggest that progress is more or less advanced than it is for a measure without a narrative.

1) Broad strategy: management and coordination

Management and coordination are fundamental components of the recovery of an imperilled species. This is especially true for Redside Dace, a species that is scattered among fragmented stream sections in southern Ontario watersheds that are within the jurisdictions of multiple agencies and the areas of interest of numerous non-governmental organizations. It is important that information from research is amalgamated, analyzed, and presented in a standardized fashion, so that managers from multiple organizations can make decisions based on the best available information. Similarly, coordination amongst planners, biologists, and engineers could lead to improvements in the urban development process to reduce or eliminate negative impacts to streams occupied by Redside Dace.

Approach: habitat protection

Planning (measures: 1, 16) – As part of the consideration of landscape level impacts on habitat, the Redside Dace Recovery Implementation Team recognizes the “Growth Plan for the Greater Golden Horseshoe 2019” , prepared under the *Provincial Places to Grow Act, 2005*. The plan sets out population, density, and employment targets. It is intended to support growth through good planning, which may require high-density development or re-development in some urbanized areas and limiting urban sprawl in other areas. The Redside Dace Recovery Implementation Team acknowledges that intensively developed areas will present additional challenges to the protection of Redside Dace and its habitat. For this reason, it is especially important that subwatersheds supporting Redside Dace in areas not yet developed, and outside of designated high-density growth areas, be effectively managed and protected. Activities that occur adjacent to identified critical habitat (riparian vegetation/meander belt/stream) can still damage or destroy such habitat features, particularly when they negatively impact the existing magnitude, timing, and frequency of stormwater flows. It is imperative to integrate Redside Dace habitat protection into the urban development planning process, particularly with regard to stormwater management and Low Impact Development; this can be achieved by incorporating the guidelines for development in Redside Dace habitat in the municipal planning process.

Drainage (measure 4) – It is important to work closely with drainage supervisors and managers to avoid and/or reduce potentially negative impacts on Redside Dace habitat from drain maintenance activities such as cleanouts. These activities can impact Redside Dace indirectly by reducing water quality within watersheds due to the introduction of sediments and nutrients. In addition, YOY Redside Dace are thought to dwell in small intermittent tributaries and oxbows, such as drains; therefore, maintenance activities may also directly impact the species through the harassment or death of the individual, as well as through destruction or alteration of its habitat.

Approach: threat evaluation

Species introductions (measures 2, 5, and 18) – A precautionary approach should be taken with respect to intentional non-indigenous fish species introductions and the removal of barriers that might lead to these species being introduced into Redside Dace streams. Intentional introductions of non-indigenous fish species, including native species undergoing range expansions as a result of barrier removal, into Redside Dace habitat should be avoided and every effort should be made to find alternative locations for introductions. Removal of barriers should be encouraged in areas where Redside Dace populations have been fragmented, and the removal of the barrier will not result in the upstream introduction of invasive fish species. Managing non-indigenous species (for example, Brown Trout) within Redside Dace habitat, to reduce or in some cases eliminate them, should be a consideration in the work to recover Redside Dace.

Protection of Redside Dace from the effects of invasive species and non-indigenous species relies on existing fisheries partitions in a number of watersheds. Fisheries partitions, whether an existing dam or natural waterfall, segregate Redside Dace from these species. There are 15 known structures acting as partitions across the range of Redside Dace in Ontario (refer to appendix D). Non-indigenous species, such as Brown Trout, Rainbow Trout, and Northern Pike have been associated with negative impacts on Redside Dace populations through direct competition and eventual elimination. Existing partitions should be reviewed to determine whether they remain an effective partition and new partitions are to be identified where they can be used to protect Redside Dace habitat from both invasive species (for example, Round Goby is expanding its range in the Humber and Rouge River watersheds) and non-indigenous species.

Harvest management (measure 17) – Although the likelihood of Redside Dace being captured by baitfish harvesters is relatively low (refer to Threats section) compared to other non-target species (Drake and Mandrak 2014a), further action needs to be taken to increase education and awareness of Redside Dace and how it differs from common species, to develop harvesting best management practices (BMPs) that will mitigate impacts to Redside Dace and its habitat, and to continue to protect Redside Dace by restricting baitfish harvesting during the spawning period.

Approach: habitat improvement

Rehabilitation (measure 19) – Information acquired from the assessment of rehabilitation potential (measure 7) should be used to identify areas where new rehabilitation projects should be initiated. These areas would focus on stream sections where Redside Dace was historically abundant and that are connected to occupied reaches. Rehabilitation projects should also be focused in historical reaches unconnected to currently occupied reaches if there is a high potential to improve habitat conditions and threats are abated such that the species can be reintroduced. Priority streams should be identified in collaboration with the Redside Dace Recovery Implementation Team.

Best management practices and farm planning (measures 20, 21) – Focus on improving stream habitat conditions for Redside Dace in rural towns, as well as areas where farming land use practices threaten water quality. Encourage the use of BMPs in rural streams to restore healthy riparian vegetation, reduce livestock access, establish manure storage and run-off collection systems, encourage conservation tillage, and reduce the impact of tile drains. Riparian rehabilitation should focus on the re-establishment of grasses and shrubs. The adaptation of such practices would improve Redside Dace habitat by reducing agricultural run-off and bank erosion, thereby limiting the input of sediments and nutrients from agricultural lands.

2) Broad strategy: inventory and monitoring

In 1985, the Royal Ontario Museum conducted specific field surveys to assess Redside Dace populations, and in the last 20 years considerable efforts have been undertaken to examine Redside Dace populations in Ontario; however, most of the monitoring of Redside Dace populations in Ontario has been ad hoc or has been incidental to other sampling programs.

Approach: assessment

Monitoring program (measure 6) – Monitoring is needed to identify if populations are extant, determine their area of occupancy and relative abundance, and explore the health of the riparian vegetation. In addition to these survey requirements, a need exists to establish a long-term monitoring program that can provide reliable trend-through-time information on the status of Redside Dace populations and their habitats in Canada. Wilson and Dextrase (2008) developed a sampling protocol for Redside Dace, which has been expanded upon in a Canadian Science Advisory Secretariat (CSAS) process undertaken by DFO and OMNRF. A CSAS meeting was held in February 2020 to determine the amount of effort and statistical power required for an occupancy-based Redside Dace monitoring program across spatial and temporal scales. Preliminary results suggest that many (>50) sites are needed to detect changes in occupancy through time, while repeat sampling at each site (3 or more passes) is needed to assess Redside Dace occurrence (Lamothe et al. 2020). Results from this work along with the guidance developed by Wilson and Dextrase (2008) can be used in future to guide the development of effective long-term monitoring programs in watersheds occupied by Redside Dace. Given the high number of Redside Dace streams, it is important to conduct regular extensive monitoring to assess Redside Dace occurrences on an ongoing basis. It is also important to conduct more intensive monitoring to assess habitat and population abundance at a subset of sites, as well as to assess habitat features within a watershed. This will allow for a more detailed assessment of temporal trends at representative sites in the province. Monitoring efforts should employ gear types proven effective at detecting Redside Dace (that is, backpack electrofishing, seining, underwater cameras).

Habitat quality (measure 7) – The status of Redside Dace habitats needs to be assessed to identify priority sites for restoration (for example, riparian rehabilitation, restoration of hydrology), as populations have declined in a number of streams throughout their distribution (section 4.2). The removal of barriers should also be considered to re-connect populations that have been fragmented, where possible and appropriate. The feasibility of rehabilitating or restoring degraded and extirpated populations, as well as habitat features such as the riparian vegetation, meander belt and headwaters, has not been assessed. It is likely that restoration is not feasible in some watersheds due to the extent and nature of changes in the watershed.

3) Broad strategy: research

There are several gaps in knowledge related to the distribution, abundance, biology, and factors that limit Redside Dace populations in Ontario. Only the highest priority research needs are identified in tables 6 and 7. The recovery implementation team will collaborate with other groups that are addressing similar issues at a watershed scale (for example, conservation authorities, university researchers).

Approach: habitat requirements

Fluvial geomorphology (measure 22) – The differences in stream channel form and flow conditions between optimal and poor habitats need to be determined. This will provide an enhanced understanding of the habitat requirements of the Redside Dace, allowing for greater efficacy in the identification and protection of critical habitat. Similarly, the conclusions of such research might contribute to future urban development guidelines as well as stream restoration projects.

Approach: assessment

Genetics (measure 8) – Microsatellites have been developed and can be used on Ontario's Redside Dace populations (Pitcher et al. 2009). Transcriptomics of Redside Dace representing functional genomics specific to thermal stress have been determined and will provide a transcriptome for future functional genomics work (T. Pitcher, University of Windsor, pers. comm. 2020). Additional studies are assessing genetic diversity of an experimentally reintroduced population and the effectiveness of eDNA sampling in winter months (T. Pitcher, pers. comm. 2020).

A number of knowledge gaps remain regarding the genetics of the Redside Dace and although research has been conducted to examine the population structure and diversity of the species (Serrao et al. 2017a), further questions exist. Additional research could examine the variation in functional genes and adaptations that would help to understand the potential for populations to adapt to changing environments; this research could also inform the selection of source populations for translocations or hatchery rearing.

Approach: threat evaluation

Introduced species (measure 9) – Interactions between Redside Dace and introduced fishes have not been specifically studied. Declines have been observed after the introduction of predatory fishes and minnow species in Ontario streams. Salmonids (especially Brown Trout), Northern Pike, centrarchids (bass and sunfishes) and other leuciscids (minnows) are species of particular concern in this regard, but further research is required to determine cause and effect. Research into such community interactions would indicate: a) whether the removal of certain introduced species affects the abundance and distribution of Redside Dace, b) which species are important competitors/predators, and c) the interactions/impacts of the species most often introduced into Redside Dace streams.

Urban and agricultural impacts (measure 10) – Activities on the landscape beyond the associated riparian habitat can have profound cumulative impact(s) on Redside Dace habitat, in urban areas as well as rural agricultural lands. It is also important to note that past BMPs limited to practices directly affecting stream channels have typically been ineffective in addressing changes in water balance and water quality. Therefore, recovery actions are necessary at the broader watershed level to protect and rehabilitate habitat. For this reason, research investigations are needed to test the effectiveness of current and new mitigation or restoration measures. For example, research into the widespread implementation of Low Impact Design infrastructure (for example, infiltration trenches, tree pits) is required to determine its effectiveness in mitigating the increases of impervious cover on sensitive fish communities.

Approach: re-introductions

Artificial rearing and translocations, candidate locations (measures 11, 12) – Investigate the potential for stocking as a tool for Redside Dace recovery. This might include the rearing of specimens within aquaculture facilities, or alternatively, the transfer of wild fish specimens from a stable donor population. Some progress has been made with respect to rearing Redside Dace in captivity; specimens, collected from healthy populations in Ohio, are being housed in aquaculture facilities in the Freshwater Restoration Ecology Centre at the Great Lakes Institute for Environmental Research (University of Windsor) as a captive breeding experimental research population. Captive breeding trials are underway to examine the use of hormones and environmental cues (for example, light cycle, water temperature) to stimulate breeding (T. Pitcher, pers. comm. 2020).

With respect to wild transfers, donor populations should be carefully selected to ensure that translocated individuals are likely to experience adequate fitness relative to their new environment. Appropriate life stage for re-introduction should be considered. Connected stream sections that were previously occupied, with the potential to sustain translocated or stocked Redside Dace, will also be identified to increase the likelihood of success and to ensure gene flow with other subpopulations. Lamothe et al. (2021) used the Aquatic Ecosystem Classification system to describe Redside Dace habitat, which could be used as a model to assess the suitability of re-introduction sites. Any re-introduction efforts for Redside Dace should follow the decision-support framework for the conservation translocation of SARA-listed freshwater fishes (Lamothe et al. 2023).

4) Broad strategy: stewardship and outreach

To meet the population and distribution objectives outlined in section 6, it is imperative that DFO foster improved communication networks to increase awareness of Redside Dace recovery initiatives. Such improvement includes enhancing public awareness of this species as well as its habitat, which would include increased communications with other government agencies, Indigenous Nations, municipal planning authorities, academia, and environmental non-government organizations (ENGOs). Outreach initiatives intended to enhance public awareness of this species might include social media campaigns, presentations at community events, as well as the dissemination of species information.

Approach: awareness

Awareness strategy, outreach (measures 13,14) – The development of an awareness plan is necessary to provide for a coordinated approach to the production and distribution of awareness materials. The goal of the plan will be to generate awareness regarding the significance of Redside Dace and the protection of its habitats, to promote private land stewardship and to help engender public support for implementation of recovery actions. The plan will engage Indigenous Nations communities and a variety of stakeholders, including government agencies, municipalities, agricultural community, urban development community, environmental groups, stewardship councils, school groups, and private landowners. Awareness and outreach activities should focus on lands that support critical habitat. The plan will identify potential funding sources and partners that will assist in delivering the awareness program.

8 Critical habitat

8.1 Identification of Redside Dace critical habitat

8.1.1 General description of Redside Dace critical habitat

Critical habitat is defined in SARA as "…the habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species". [subsection 2(1)]

Also, SARA defines habitat for aquatic species as "… spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced." [subsection 2(1)]

For Redside Dace, critical habitat[18] has been identified to the extent possible, using the best information currently available, and provides features necessary to support the species' life-cycle functions.

This recovery strategy and action plan identifies the features of critical habitat for Redside Dace as run, riffle, or pool areas in stream reaches with slow to moderate flow for juveniles and slow to fast flow for adults, within the entire bankfull channel width.

Additional features of critical habitat include the meander belt width, 30 m of riparian vegetation within it, and associated 30 m of vegetated area extending from the meander belt width. The exception to this is for critical habitat identified within municipal drains (as classified under Ontario's *Drainage Act*) that have been previously channelized. In these cases, critical habitat includes the entire bankfull channel stream width, as well as 30 m of riparian vegetation on each side of the bankfull channel (that is, the meander belt is not included).

The areas within which critical habitat can be found include the watersheds of Two Tree River, Saugeen River, Gully Creek, Unknown Stan J, Irvine Creek, Spencer Creek, Bronte Creek, Fourteen Mile Creek, Sixteen Mile Creek, Credit River, Humber River, Don River, Rouge River, Duffins Creek, Carruthers Creek, Lynde Creek, and the Holland River.

Note that anthropogenic structures within the delineated areas that may be present within the riparian habitat are specifically excluded.

It is unknown if the critical habitat identified in this recovery strategy and action plan is sufficient to achieve the species' population and distribution objectives. The schedule of studies outlines the research required to acquire more detailed information about the critical habitat identified to achieve the species' population and distribution objectives.

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[18] The identification of critical habitat (CH) was partially based on the habitat identified under the Ontario *Endangered Species Act* (ESA) but, given the time that has passed since that habitat was identified (and new information), the CH identified in this document is not precisely the same as that identified under the ESA.

8.1.2 Information and methods used to identify critical habitat

The location(s) of the critical habitat's features and attributes have been identified using a bounding box. This means that the critical habitat does not comprise all areas within the identified boundaries, but only those areas within the identified geographical boundaries where the described biophysical feature and the function it supports occur.

Within the streams currently occupied by Redside Dace, an ecological classification system was used to delineate the bounding box. The OMNRF's Aquatic Resource Areas (ARA) (OMNRF 2009) mapping was used as the base unit for defining stream reaches. ARAs are aggregations of stream segments with similar physical and biological characteristics. Therefore, if the species has been found in one part of an ARA, it would be reasonable to expect that it would be present in other spatially contiguous areas of the same stream segment. Current occupancy for this species was defined by records of live individuals from 2000 onward. The bounding box also includes formerly occupied stream reaches within occupied or adjacent subwatersheds where there is a reasonable likelihood of successful stream corridor rehabilitation and re-colonization (natural or assisted).

Within all identified stream segments (that is, the bounding box), aquatic features of critical habitat for Redside Dace include run, riffle, or pool areas in stream reaches with slow to moderate flow for juveniles and slow to fast flow for adults, within the entire bankfull channel width[19]. Other features of critical habitat include the meander belt width of the stream, 30 m of riparian vegetation within it, and associated vegetated areas extending 30 m from the meander belt width (measured horizontally) (figure 4). The inclusion of these critical habitat features recognizes the naturally dynamic nature of riverine systems (stream channels move within the meander belt over time) and the importance of riparian habitat to highly sensitive stream ecosystems that support Redside Dace. This is consistent with guidance provided in the CSAS research document "Review of information to guide the identification of critical habitat in the riparian zone for listed freshwater fishes and mussels" (Caskenette et al. 2020). Caskenette et al. (2020) state that riparian features should be considered critical habitat when they: 1) are necessary to maintain aquatic features and/or water quality attributes of aquatic features identified as critical habitat; and/or, 2) support the life-cycle functions necessary for the survival or recovery of listed freshwater fishes and mussel species or their host species. Specifically, for Redside Dace, width of the meander belt should be considered critical habitat as the species is found in streams prone to meandering (Caskenette et al. 2020). The inclusion of these features is also consistent with science-based guidelines developed for guiding habitat rehabilitation in Great Lakes Areas of Concern, which recommend a minimum of 30 m of naturally vegetated adjacent lands on both sides of the stream (Environment Canada 2004). Over the long term, the meander belt and riparian vegetation are essential to the maintenance of instream habitat attributes required to support the needs of Redside Dace.

The exception to the above description is for critical habitat identified within reaches of municipal drains[20] (as classified under Ontario's *Drainage Act*) that have been previously channelized. In these cases, features of critical habitat are the same as above, with the exception of the meander belt. In municipal drains that have been previously channelized, the

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[19] Bankfull channel width is the width of the stream or river at bankfull discharge, which is the flow at which water begins to leave the channel and move into the floodplain.
[20] For more information on municipal drains see Kavanagh et al. (2017).

meander belt is not included as a feature of critical habitat given the extent of anthropogenic alteration to the stream channel and flood plain. Note that although these watercourses are classified as municipal drains, the likelihood of maintenance being required is low for the majority of them.

8.1.3 Identification of critical habitat

Geographic information:

The areas delineated on the following maps (figures 5 to 18) and in table 8 represent the extent of the area within which critical habitat is found (that is, the bounding box) that can be identified at this time. As mentioned previously, critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

For Redside Dace, critical habitat is identified within the following watersheds:

1. Two Tree River and tributaries
2. Saugeen River and tributaries
3. Gully Creek and tributaries
4. Unknown Stan J
5. Irvine Creek and tributaries
6. Spencer Creek and tributaries
7. Bronte Creek and tributaries
8. Fourteen Mile Creek and tributaries
9. Sixteen Mile Creek and tributaries
10. Credit River and tributaries
11. Humber River and tributaries
12. Don River and tributaries
13. Rouge River and tributaries
14. Duffins Creek and tributaries
15. Carruthers Creek and tributaries
16. Lynde Creek and tributaries
17. Holland River and tributaries

Note that anthropogenic structures (for example, bridge piers, driveways, buildings) currently within critical habitat (including riparian vegetation, and meander belt and/or 30 m vegetated area) are specifically excluded; it is understood that maintenance or replacement of these structures may be required at times.[21] Additionally, current agricultural production within the 30 m of riparian vegetation may continue, provided the function of the riparian vegetation is not diminished.

Explanations for the bounding boxes within which critical habitat is identified are provided below.

[21] Depending on the type of work, it is encouraged that an application for a permit be submitted before work is conducted, to assess potential impacts to adjacent critical habitat.

Two Tree River: The bounding box in the Two Tree River includes the entire Two Tree River watershed (figure 5). This represents a total river reach approximately 46 km long.

Saugeen River and tributaries: The bounding box in the Saugeen River and tributaries (figures 6a and b) and Meux Creek (figure 6c) represents a total river reach of approximately 107 km in length and is described as follows:

- in the Saugeen River, beginning from a point where the river flows through the Osprey Wetland Conservation Lands, approximately 900 m downstream of Centre Line and east of County Road 2, to a point approximately 1 km[22] downstream of Concession 2, south of Durham Road East, in Glenelg Township
- in several shorter sections of small, unnamed tributaries that join the Saugeen River: beginning in a tributary approximately 1.5 km upstream of 41a Road, south of 3rd Concession; beginning in 2 tributaries approximately 1.7 km and 1.2 km, respectively, upstream of Centre Line, west of 41a Road; beginning in a tributary just upstream of Southgate Road 26; beginning in a tributary approximately 500 m upstream of Gillies Lake, west of Wilcox Lake Road; beginning in a tributary approximately 50 m downstream of Southgate Sideroad 13, and 1.5 km upstream from Southgate Township Road 26; beginning in a tributary approximately 500 m downstream of Southgate Sideroad 13, north of Southgate Township Road 24; beginning in a tributary approximately 500 m downstream of County Road 14, south of Southgate Township Road 24; beginning in a tributary approximately 500 m downstream of S Line, west of Artemesia Glenelg Town Line; beginning in a tributary approximately 2.5 km upstream of N Line, west of Artemisia Glenelg Townline; and, lastly, beginning in a tributary approximately 750 m upstream of Concession Road 4, just east of Baptist Church Road. The area continues downstream in all of these aforementioned tributaries to their points of confluence with the main branch of the Saugeen River.
- within Meux Creek and Shannon Drain; this area represents a total river reach of approximately 32 km in length. In Meux Creek, this reach extends from a point approximately 2 km upstream of Highway 89, north of Minto Line 12, downstream to a point approximately 1 km upstream of Queen Street, west of Grey Road 10, near Neustadt. In Shannon Drain, beginning approximately 750 m upstream of Side Road 10, south of Concession Road 6, and continuing downstream to its point of confluence with Meux Creek.

Gully Creek and tributaries: The bounding box within the Gully Creek watershed (figure 7) represents a total river reach of approximately 16 km and can be described as follows:

- in Gully Creek, beginning at the confluence of the north and south branches, approximately 400 m upstream of Porters Hill Line, and continuing downstream to the outlet into Lake Huron
- in Gully Creek North Branch and tributaries: in Gully Creek North Branch, beginning approximately 1 km upstream of Tower Line Road and continuing downstream to the confluence with the main branch of Gully Creek; in Gully Creek North Branch Tributary B, beginning approximately 200 m downstream of Whys Line, and extending down to the confluence with the North Branch; and, in an unnamed tributary, beginning

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[22] Note that distances described in the critical habitat descriptions are in river km.

approximately 200 m downstream Whys Line and extending downstream to the confluence with the North Branch

- in Gully Creek South Branch and tributaries: in Gully Creek South Branch, beginning approximately 1 km upstream of Telephone Road and extending downstream to the confluence with the main branch of Gully Creek; in Gully Creek South Branch Tributary A, beginning approximately 250 m downstream of Whys Line and extending to the confluence with the South Branch; and, in 2 unnamed tributaries, beginning approximately 300 m downstream of Whys Line and beginning at Whys Line, respectively, continuing past their confluence and extending to the confluence with the South Branch

Unknown Stan J: The bounding box in Unknown Stan J (figure 8) represents a total section of stream approximately 6 km in length. The area originates upstream at a point approximately 600 m upstream of Centennial Road, east of Bronson Line and extends downstream to the creek's outlet at Lake Huron.

Irvine Creek and tributaries: The bounding box in Irvine Creek (figure 9), including Snow Drain, represents an approximately 23 km stretch. The area can be described as follows:

- in Irvine Creek, beginning approximately 1.5 km upstream of Wellington County Road 109, west of E West Luther Townline, and continuing downstream to a point approximately 300 m downstream of Side Road 15
- in Snow Drain, originating in 3 tributaries: in the first, beginning approximately 750 m upstream of 3 Line; in the second, beginning approximately 2.5 km upstream of Sideroad 20, west of Wellington Road 16; and, in the third tributary, beginning approximately 300 m upstream of Wellington Road 16. The area extends down each of the aforementioned tributaries to their confluence (in the area bounded by Side Road 25, Side Road 20, Wellington Road 16, and 3 Line), and continues downstream to the confluence with Irvine Creek, just upstream of 5th Line.

Spencer Creek and tributaries: The bounding box within this creek (figure 10) includes Flamborough Creek and represents approximately 30 km within Spencer and Flamborough creeks. The area can be described as follows:

- in Spencer Creek and two tributaries: in Spencer Creek, beginning approximately 1.5 km upstream of Concession 8 West, east of Valens Road, continuing downstream to the confluence of Spencer Creek and Flamborough Creek, and extending beyond that to a point on the eastern border of Century Pines Golf Course, approximately 850 m downstream of Concession 4 West; in the first tributary, beginning at Westover Road, south of Safari Road, and extending downstream to the confluence with Spencer Creek; and, in the second tributary, beginning at a location approximately 750 m south of Concession 5 West and extending downstream to the confluence with Spencer Creek
- in Flamborough Creek, beginning at a point approximately 500 m downstream of Gulliver's Lake and extending downstream to the confluence with Spencer Creek

Bronte Creek and tributaries: The bounding box within this creek (figure 10) represents a stretch of creek approximately 40 km long. The area is described as follows:

- in Bronte Creek, beginning at a point approximately 250 m upstream of Concession Road 14 East and continuing to a point approximately 450 m downstream of Carlisle Road, near the town of Carlisle
- in 2 unnamed tributaries: in the first tributary, beginning approximately 30 m east of a pond and wetland system south of Regional Road 97 and continuing downstream to the confluence with Bronte Creek, just east of Brock Road; and, in the second tributary, beginning approximately 250 m upstream of Mountsberg Road and continuing downstream to the confluence with Bronte Creek
- in Mountsberg Creek, beginning at the Mountsberg Reservoir outlet and continuing downstream to the confluence with Bronte Creek, outside the town of Carlisle

Fourteen Mile Creek and tributaries: The bounding box in this creek and 4 tributaries (figure 11) represents approximately 18 km of stream reach. The area can be described as follows:

- in Fourteen Mile Creek, originating approximately 1 km downstream of Highway 407 and 750 m southwest of Bronte Road and extending downstream to the railway line, south of the Queen Elizabeth Way (QEW)
- in several smaller, unnamed tributaries: in a tributary, beginning immediately upstream of Tremaine Road, approximately 100 m southeast of Highway 407; in a tributary, beginning at Dundas Street West, east of Bronte Road; in a tributary, beginning approximately 200 m east of Bronte Road, south of Upper Middle Road West; in a tributary, beginning at Third Line approximately 500 m north of the QEW/403; and, in a tributary, beginning approximately 150 m south of Advance Road. The area continues down each of the aforementioned tributaries to their confluences with Fourteen Mile Creek

Sixteen Mile Creek and tributaries: The bounding box within this creek (figure 12) includes tributaries of Middle Sixteen Mile Creek; this represents approximately 52 km within the Sixteen Mile Creek watershed. The area can be described as follows:

- in the western-most branches of Sixteen Mile Creek: beginning approximately 1.5 km upstream of 15 Side Road, adjacent to Fifth Line Nassagaweya; and, beginning approximately 100 m upstream of Nassagaweya-Esquesing Townline, south of 15 Side Road. The area extends down each tributary to their confluence (at the northeast perimeter of Hilton Falls Conservation Area) and continues downstream to a point immediately upstream of Kelso Lake. In a small tributary, beginning immediately downstream of the pond south of Campbell Avenue, and extending to the confluence with Sixteen Mile Creek
- in the middle branches of Sixteen Mile Creek, northwest of Milton: in Sixteen Mile Creek West Branch, beginning in Grey Stone Golf Club, just east of the end of Dublin Line, and continuing downstream to Steeles Avenue East; and, in an unnamed tributary, beginning approximately 1 km upstream of Campbellville Road, just west of Tremaine Road, and continuing downstream to Martin Street
- in Middle Sixteen Mile Creek (Hornby East Branch A) and one of its tributaries: originating just south of 10 Side Road, west of Fourth Line, and approximately 150 m upstream of 10 Side Road just west of Sixth Line, respectively. The area continues in these 2 stream sections downstream until their confluence approximately 50 m west of Sixth Line and north of Steeles Avenue

Credit River and tributaries: The bounding box within this river (figures 13a, b, c) includes portions of the upper watershed, Credit River (West Branch) (Silver Creek and Black Creek), and lower watershed (including Fletcher's, Huttonville, Springbrook, Churchville, and Levi's creeks). This represents approximately 94 km within the Credit River watershed and is described as follows:

Credit River and Erin Branch: Within the Credit River, beginning at a point south of the Forks of the Credit Provincial Park boundary and extending downstream to a point approximately 750 m downstream of McLaughlin Road; and, in the Erin Branch of the Credit River, beginning approximately 400 m upstream of the confluence with the Credit River and extending downstream to said confluence.

Credit River (West Branch): The bounding box in the Credit River (West Branch) watershed (Silver Creek and Black Creek) is described as follows:

- within Silver Creek and 2 of its tributaries: in an unnamed tributary, beginning at Fallbrook Trail and continuing downstream to the confluence with Silver Creek; in Silver Creek, beginning at Side Road 27 and continuing down to a point approximately 500 m north of Eighth Line; and, in Snows Creek, beginning at 8 Line, south of Side Road 27, and continuing downstream until the confluence with Silver Creek
- within Black Creek and a tributary: beginning approximately 500 m downstream of 5th line, within Limehouse Conservation Area, and continuing downstream to the confluence with Silver Creek; and, in an unnamed tributary (known locally as Beeney Creek), beginning approximately 800 m upstream of 22 Side Road and continuing downstream to the confluence with Black Creek

Lower Credit River: The bounding box in the lower Credit River watershed (Credit River, Levi's, Huttonville, Springbrook, and Fletcher's creeks, and Churchville Tributary) is described as follows:

- within the Credit River, beginning at the confluence with Huttonville Creek, and extending downstream to the confluence with Fletcher's Creek, just upstream of Credit Meadows Park
- within Levi's Creek, beginning approximately 1 km upstream of Embleton Road and continuing downstream to the confluence with the main branch of the Credit River just south of Derry Road West
- within Huttonville Creek and a tributary: beginning in Huttonville Creek, approximately 400 m upstream of the rail line on the west side of Mississauga Road, extending downstream to the confluence with the east tributary just upstream of Bovaird Drive West; and, in the east tributary, beginning approximately 800 m upstream of Sandalwood Parkway West on the east side of Mississauga Road and extending downstream to the confluence with the Credit River
- within Springbrook Creek and tributaries: originating in Springbrook Creek near Williams Parkway and continuing downstream to the confluence with the Credit River main branch. In the first unnamed tributary, beginning approximately 500 m upstream of Queen Street West, east of Springbrook Creek, and continuing downstream to the confluence; and, in the second unnamed tributary, beginning at Queen Street West, west of Springbrook Creek, and continuing to the confluence with Springbrook Creek

- within Churchville Tributary and an unnamed tributary: beginning in Churchville Tributary approximately 950 m upstream of Queen Street West and continuing downstream to the confluence with the main branch of the Credit River; and, in an unnamed tributary, beginning just southeast of Drinkwater Road and continuing downstream to the confluence with Churchville Tributary
- within Fletcher’s Creek and 3 unnamed tributaries: in Fletcher’s Creek, beginning approximately 350 m downstream of McLaughlin Road, north of Sandalwood Parkway West, and extending downstream to the confluence with the Credit River, just upstream of Credit Meadows Park. In the first unnamed tributary, beginning just upstream of Sandalwood Parkway West, west of Brisdale Drive; in the second unnamed tributary, beginning just downstream of Amboise Crescent; and, in the third unnamed tributary, beginning just east of Chinguacousy Road, north of Sandalwood Parkway West. The area extends downstream in each tributary to their confluences with Fletcher’s Creek, just upstream of Bovaird Drive West.

Humber River and tributaries: The bounding box within this river (figures 14a, b, c) includes portions of the West Humber River (including Salt Creek), upper Humber watershed (including Cold Creek), and the East Humber River (including Purpleville Creek). This represents a total of 218 km of river reach within the Humber River watershed.

West Humber River: The bounding box in the West Humber River watershed is described as follows:

- beginning in an unnamed tributary approximately 250 m upstream of Airport Road, south of Sandalwood Parkway East, extending downstream to the confluence with the main branch, upstream of Queen Street East
- in Kilmanagh Creek, and 3 unnamed tributaries: in Kilmanagh Creek, beginning in a section approximately 900 m upstream of Old School Road, east of Kennedy Road; in the first unnamed tributary, beginning approximately 1 km downstream of Bramalea Road, just west of the Mayfield Golf Course; in the second unnamed tributary, beginning approximately 500 m downstream of King Street; and, in the third unnamed tributary, beginning approximately 700 m downstream of Bramalea Road. The area extends downstream to the confluence with the West Humber River (approximately 1 km upstream from Castlemore Road)
- in Salt Creek, beginning approximately 850 m downstream of King Street, west of Airport Road, extending to the confluence with the main branch of the West Humber River
- in Lindsay Creek, beginning south of King Street, approximately 150 m downstream from The Gore Road and extending downstream to the confluence with the West Humber River
- in the West Humber River, beginning approximately 550 m upstream of Centreville Creek Road and extending downstream to Queen Street East
- in an unnamed tributary, beginning just downstream of Castlemore Road, east of The Gore Road, and continuing downstream until the confluence with the West Humber River

Upper Humber River: Beginning approximately 900 m upstream of Concession Rd 5 and continuing downstream to where the river crosses Hickman Street in the town of Bolton; and, in an unnamed tributary, beginning approximately 1 km downstream of Old Church

Road, west of Duffy's Lane, and continuing downstream to the confluence with the Humber River

East Humber River: The bounding box identified in the East Humber River is described as follows:

- in the East Humber River, beginning approximately 380 m downstream of Bathurst Street (east of King City), north of King Road and extending to its confluence with the Humber River at Doctors McLean District Park
- in an unnamed tributary, beginning approximately 800 m downstream of 15th Sideroad, west of Dufferin Street, and extending downstream to its confluence with the East Humber River
- in 3 tributaries: in the first, beginning just south of Nobleton at the Highway 27 crossing and continuing to the confluence east of 8th Concession Road; in the second, beginning north of Nobleton, approximately 500 m downstream of 15th Sideroad and continuing to the confluence with the first tributary just south of King Road; and, in the third, beginning at 8th Concession Road, north of 15th Sideroad, and continuing to its confluence with the first and second tributaries. The area extends down each tributary to the confluence with the East Humber River
- in Marigold Creek and a small unnamed tributary: in the unnamed tributary, beginning at Pine Valley Drive, south of Major Mackenzie Drive West, and continuing downstream to the confluence with the East Humber River, south of Rutherford Road; and, in Marigold Creek, beginning at Pine Valley Drive, just south of the first tributary, and continuing downstream approximately 70 m to the confluence with the first unnamed tributary
- in Purpleville Creek and tributaries: in the first tributary, beginning just downstream of Highway 400, south of Kirby Road; in the second, beginning just upstream of Kirby Road, west of Highway 400; in the third, beginning approximately 300 m upstream of Weston Road; in the fourth, beginning approximately 650 m upstream of Teston Road, east of Pine Valley Drive; in the fifth, beginning just downstream of Kipling Avenue, south of Kirby Road; and, in a small section of a stream flowing into the fifth tributary, just upstream of Teston Road. These tributaries join approximately 1 km upstream of Major Mackenzie Drive West to form Purpleville Creek, and the area extends downstream to the confluence with the East Humber River

Don River (East Branch) and tributaries: The bounding box within this river (figure 15) includes portions of the East Branch. Overall, this represents approximately 20 km within the Don River watershed and is described as follows:

- in 2 tributaries: in the first beginning immediately upstream of Mill Street (north of Major Mackenzie Drive West and east of Bathurst Street); and, in the second, beginning at Elgin Mills Road West. The area extends down each tributary to where they merge approximately 450 m upstream of Carrville Road, and continues downstream to the confluence with the Don River at Webster Park
- in 2 tributaries: the first, beginning approximately 500 m downstream of Dufferin Street; and, in the second, beginning approximately 250 m upstream of Marc Santi Boulevard. The area extends to the confluence of both tributaries and continues downstream to a point in Uplands Golf Club, approximately 800 m downstream of the crossing at Highway 407

Rouge River and tributaries: The bounding box within this river (figure 16), includes portions of Berczy Creek, Bruce Creek, Little Rouge Creek, Robinson Creek, and Morningside Creek. This represents approximately 105 km within the Rouge River watershed and can be described as follows:

- in 3 tributaries of the Rouge River: in the easternmost unnamed tributary, it begins just upstream of Stouffville Road, west of Leslie Street, while in Tributary A it originates approximately 400 m upstream of 19th Avenue, west of Leslie Street. The area extends to the confluence of these 2 tributaries, approximately 300 m upstream of Elgin Mills Road East. In Tributary B, it begins approximately 250 m upstream of Bayview Avenue, south of Elgin Mills Road East and continues to the confluence with Tributary A just upstream of Major Mackenzie Drive East. The area extends downstream to a point approximately 500 m north of Highway 7 where Bruce Creek joins the Rouge River

- in Berczy Creek and a tributary: in Berczy Creek, beginning approximately 250 m upstream of Stouffville Road, just east of Highway 404, and continuing downstream to Toogood Pond Park where the confluence with Bruce Creek occurs. In a tributary to Berczy Creek, the area begins at Woodbine Avenue, south of Major Mackenzie Drive East, and continues to its confluence with Berczy Creek just east of Warden Avenue

- in Bruce Creek and a tributary: within 2 sections of Bruce Creek, the first beginning at Stouffville Road, just east of Warden Avenue, and continuing downstream to the confluence with Berczy Creek, south of 16th Avenue; and, in the second, beginning at the outlet of the pond in Toogood Pond Park, and continuing downstream to the confluence with the Rouge River. Within an unnamed tributary of Bruce Creek, beginning approximately 200 m upstream of Elgin Mills Road East (between Warden Avenue and Kennedy Road) and continuing downstream to the confluence with Bruce Creek

- in Robinson Creek, beginning approximately 550 m upstream of the crossing at Major Mackenzie Drive East, west of McCowan Road, and continuing downstream to a point just upstream of the pond at the Milne Dam Conservation Park, west of Markham Road

- in Morningside Creek, beginning west of Remington Parkview Golf and Country Club, approximately 1.2 km upstream of Steeles Avenue East and continuing downstream through Rouge National Urban Park (a protected area listed under SARA subsection 58[2]) to the confluence of Morningside Creek and the Rouge River within the Toronto Zoo grounds

- Little Rouge Creek: The bounding box within Little Rouge Creek can be found in a number of tributaries and is described as follows:

  - in Little Rouge Creek, beginning approximately 750 km downstream of Stouffville Road, west of McCowan Road, extending to a point approximately 1 km downstream of Highway 48, north of Major Mackenzie Drive East
  - in 4 tributaries: in the first, beginning immediately upstream of Highway 48, south of Bethesda Sideroad; in the second, beginning approximately 600 m upstream of Bethesda Sideroad, east of Highway 48; in the third, beginning approximately 250 m upstream of 9th Line, north of Stouffville; and, in the fourth, beginning at 9th Line, just north of 19th Avenue. These tributaries all merge with one another as they flow

downstream and the area continues until the confluence with the main branch is reached, south of 19th Avenue and east of McCowan Road

- in a fifth tributary, beginning just downstream of 9th Line, approximately 750 km north of Elgin Mills Road East, and extending downstream to the confluence with Little Rouge Creek

Duffins Creek and tributaries: The bounding box within this creek (figure 17) includes portions of Urfe, Ganatsekiagon, Brougham, and Michell creeks. This represents approximately 64 km within the Duffins Creek watershed and is described as follows:

- in Ganatsekiagon Creek, starting in 4 tributaries: in the first tributary, beginning approximately 350 m upstream of Sideline 22, just north of Taunton Road; in the second, beginning at the Whitevale Road crossing, west of Sideline 24; and, in the third and fourth, starting at 2 Whitevale Road crossings between Sideline 24 and Sideline 20. The area extends down each tributary to the point where they merge into Ganatsekiagon Creek, and continues to a point downstream of Brock Road where it joins Urfe Creek
- in Urfe Creek and two tributaries: in the first tributary, starting from a point approximately 150 m downstream of Highway 7, west of Country Lane, continuing downstream to the confluence with Urfe Creek. The area then continues downstream in Urfe Creek to the confluence with Ganatsekiagon Creek, south of Rossland Road West. In the second tributary, starting approximately 250 m upstream of Taunton Road near the Pickering/Ajax border, and extending to the confluence with Urfe Creek, north of Rossland Road West
- in Michell Creek and 3 tributaries: in Michell Creek, beginning approximately 850 m downstream of Uxbridge Pickering Townline, east of Sideline 24 and extending downstream to the confluence with Duffins Creek, north of Concession Road 7. In 2 tributaries to Michell Creek, beginning approximately 1.5 km and 750 m upstream of Central Street, west of Sideline 20, respectively, and extending downstream to the confluence with Michell Creek, just west of Sideline 20; and, in a third tributary, beginning at the Canadian Pacific Railway crossing east of Sideline 20, and extending downstream to the confluence with Michell Creek (west of Brock Road and north of Concession Road 8)
- in Duffins Creek, starting approximately 300 m upstream of Concession Road 9, east of Westney Road North, and continuing downstream to the confluence with Brougham Creek, in Greenwood Conservation Area. In another section of Duffins Creek downstream, beginning approximately 1.8 km upstream of Highway 2, at the confluence with Urfe Creek, and continuing to a point approximately 800 m downstream of Highway 2
- in a tributary of Brougham Creek, beginning approximately 450 m upstream of Highway 407, east of Sideline 14, and continuing downstream to the confluence with Brougham Creek, and continuing in Brougham Creek to the confluence with Duffins Creek in Greenwood Conservation Area

Carruthers Creek and tributaries: The bounding box within this creek (figure 17) represents approximately 19 km of river reach within Carruthers Creek and is described as follows:

- within 2 tributaries: beginning at the stream crossings of Concession Road 7, east of Westney Road and west of Salem Road, respectively. The area extends down each tributary until their confluence before continuing downstream to the confluence of another tributary in Deer Creek Golf and Banquet Facility

- within 1 tributary: beginning at the Balsam Road crossing, south of Concession Road 7. The area extends downstream to the confluence in Deer Creek Golf and Banquet Facility, approximately 250 m upstream of Taunton Road

Lynde Creek and tributaries: The bounding box within this creek (figure 17) includes portions of West Lynde Creek. This represents approximately 74 km of stream reach within the Lynde Creek watershed and is described as follows:

- within the west branch of Lynde Creek in multiple tributaries: beginning at a stream crossing at Columbus Road West, east of Lakeridge Road; beginning at a point approximately 450 m upstream of Columbus Road West, near its intersection with Coronation Road; beginning approximately 250 m upstream of Concession Road 9, west of Lakeridge Road; beginning just upstream of Myrtle Road West, east of Lakeridge Road; beginning approximately 150 m upstream of Columbus Road West, west of Cochrane Street; and, beginning approximately 200 m downstream of Cochrane Street, south of Brawley Road West. All of these tributaries join to form the western branch of Lynde Creek in a general area in, and upstream of, Heber Down Conservation Area. The area extends down each tributary to their confluence and extends further downstream in the western branch to its confluence with Lynde Creek in D'Hillier Park, approximately 300 m upstream of Dundas Street West
- in a small section of an unnamed tributary to West Lynde Creek, beginning at Country Lane (south of Lyndebrook Road), and extending downstream to the confluence with West Lynde Creek
- in Lynde Creek and a tributary: beginning approximately 1.5 km upstream of Myrtle Road West, west of Heron Road, and extending downstream until the point of confluence with the west branch in D'Hillier Park. In a tributary beginning at Brawley Road, east of Cedarbrook Trail, and continuing downstream to the confluence with Lynde Creek

Holland River and tributaries: The bounding box within this river (figure 18) includes portions of Kettleby Creek and a tributary of the South Holland Canal. This represents approximately 24 km of river within Kettleby Creek and is described as follows:

- in a tributary of the South Holland Canal: beginning approximately 400 m downstream of 19th Sideroad, east of Highway 400, and continuing downstream to the confluence with the South Holland Canal
- in several tributaries of Kettleby Creek: in the first tributary, beginning approximately 100 m upstream of Jane Street, north of 18th Side Road; in the second, beginning approximately 250 m east of Jane Street, south of Kettleby Road; in the third, beginning approximately 250 m downstream of the crossing at Jane Street, south of Lloydtown/Aurora Road; in the fourth, beginning at Spruce Hill Road, north of 17th Side Road; in the fifth, beginning approximately 1 km upstream of Lloydtown-Aurora Road, and west of Keele Street; and, in the sixth, beginning approximately 100 m upstream of Lloydtown-Aurora Road, close to the intersection with Dufferin Street. The area extends to the points of confluence for these tributaries (in the area bounded by Kettleby Road, Jane Street, Keele Street, and Lloydtown-Aurora Road), and continues downstream to the confluence with the South Holland Canal.

Table 8**,** below, provides the geographic coordinates that situate the boundaries of the bounding boxes within which critical habitat is found for Redside Dace; these points are indicated in figures 5 to 18. Critical habitat does not comprise all areas within the identified boundaries, but only those areas within the identified geographical boundaries where the described biophysical feature and the function(s) it supports occur, as described in table 9.

Table 8. Coordinates[23] locating the boundaries of the bounding boxes within which critical habitat is found for Redside Dace.[24] Main stem waterbodies are listed first, followed by their tributaries. Tributaries were all given P1 labels except in cases where it was not clear which was the main waterbody and which was the tributary; in these cases, each endpoint was numbered consecutively (for example, P1, P2, P3, P4). Tributaries, both unnamed and named, are listed in order from upstream to downstream.

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
5	Two Tree River	46.202076, -84.074194	46.269721, -83.962775	-	-	-	-
6a, 6b	Saugeen River	44.182166, -80.792185	44.266995, -80.400191	-	-	-	-
6a	Saugeen River tributary	44.255414, -80.361350	-	-	-	-	-
6a	Saugeen River tributary	44.240221, -80.417846	-	-	-	-	-
6a	Saugeen River tributary	44.235078, -80.444039	-	-	-	-	-
6a	Saugeen River tributary	44.191579, -80.461995	-	-	-	-	-
6a	Saugeen River tributary	44.208000, -80.563632	-	-	-	-	-
6a	Saugeen River tributary	44.167914, -80.535259	-	-	-	-	-
6a, 6b	Saugeen River tributary	44.162997, -80.537199	-	-	-	-	-
6a, 6b	Saugeen River tributary	44.144341, -80.556438	-	-	-	-	-
6b	Saugeen River tributary	44.187508, -80.633068	-	-	-	-	-
6b	Saugeen River tributary	44.228848, -80.640019	-	-	-	-	-

[23] All coordinates obtained using map datum NAD 83.
[24] Riverine habitats are delineated to the midpoint of channel of the uppermost stream segment(s) and lowermost stream segment.

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
6b	Saugeen River tributary	44.238479, -80.724906	-	-	-	-	-
6c	Meux Creek	44.083538, -81.005034	43.948593, -80.857629	-	-	-	-
6c	Shannon Drain (Meux Creek tributary)	43.999806, -80.935940	-	-	-	-	-
7	Gully Creek	43.615339, -81.713168	-	-	-	-	-
7	Gully Creek North Branch tributary	43.630480, -81.659109	43.626632, -81.646292	43.622871, -81.644182	-	-	-
7	Gully Creek South Branch tributary	43.6120042, -81.647692	43.607726, -81.640133	43.601477, -81.635667	43.595822, -81.650546	-	-
8	Unknown Stan J	43.497621, -81.711200	43.490890, -81.656234	-	-	-	-
9	Irvine Creek	43.794253, -80.357571	43.863082, -80.406596	-	-	-	-
9	Snow Drain	43.795821, -80.427139	43.804923, -80.423409	43.805570, -80.409180	-	-	-
10	Spencer Creek	43.293797, -80.066632	43.373434, -80.110330	-	-	-	-
10	Spencer Creek tributary	43.340689, -80.087293	-	-	-	-	-
10	Flamborough Creek (Spencer Creek tributary)	43.354347, -80.018307	-	-	-	-	-
10	Spencer Creek tributary	43.313937, -80.068013	-	-	-	-	-
10	Bronte Creek	43.390888, -79.983713	43.433101, -80.081816	-	-	-	-
10	Unnamed Bronte Creek tributary	43.424875, -80.044384	-	-	-	-	-
10	Unnamed Bronte Creek tributary	43.380364, -80.054318	-	-	-	-	-
10	Mountsberg Creek (Bronte Creek tributary)	43.455023, -80.045652	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
11	Fourteen Mile Creek	43.422422, -79.716296	43.436789, -79.788336	-	-	-	-
11	Unnamed Fourteen Mile Creek tributary	43.433822, -79.788666	-	-	-	-	-
11	Unnamed Fourteen Mile Creek tributary	43.429068, -79.802988	-	-	-	-	-
11	Fourteen Mile Creek (East Branch)	43.4391699, -79.773315	-	-	-	-	-
11	Unnamed Fourteen Mile Creek tributary	43.421342, -79.753171	-	-	-	-	-
11	Unnamed Fourteen Mile Creek tributary	43.426713, -79.728281	-	-	-	-	-
11	Unnamed Fourteen Mile Creek tributary	43.424414, -79.715265	-	-	-	-	-
12	Sixteen Mile Creek Upper West Branch	43.505290, -79.950265	43.550717, -80.020210	-	-	-	-
12	Unnamed Sixteen Mile Creek Upper West Branch tributary	43.558573, -79.984172	-	-	-	-	-
12	Unnamed Sixteen Mile Creek Upper West Branch tributary	43.493540, -79.974514	-	-	-	-	-
12	Sixteen Mile Creek West Branch	43.524332, -79.890926	43.547990, -79.951064	-	-	-	-
12	Unnamed Sixteen Mile Creek West Branch tributary	43.524823, -79.901008	43.528871, -79.949450	-	-	-	-
12	Sixteen Mile Creek Middle East Branch	43.560534, -79.858333	43.575295, -79.929560	-	-	-	-
12	Unnamed Sixteen Mile Creek Middle East Branch tributary	43.602480, -79.913381	-	-	-	-	-
13a	Credit River	43.815914, -79.954585	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
13a	Credit River Erin Branch	43.800767, -79.996411	-	-	-	-	-
13b	Silver Creek	43.638896, -79.905365	43.690985, -79.969795	-	-	-	-
13b	Unnamed Silver Creek tributary	43.688593, -79.964994	-	-	-	-	-
13b	Snows Creek (tributary of Silver Creek)	43.686207, -79.974982	-	-	-	-	-
13b	Black Creek (tributary of Silver Creek)	43.637404, -79.976455	-	-	-	-	-
13b	Unnamed tributary of Black Creek (Beeney Creek)	43.652691, -79.972519	-	-	-	-	-
13c	Credit River	43.609508, -79.717970	-	-	-	-	-
13c	Huttonville Creek (Credit River tributary)	43.672217, -79.846349	-	-	-	-	-
13c	Unnamed Huttonville Creek tributary	43.689276, -79.843681	-	-	-	-	-
13c	Springbrook Creek (Credit River tributary)	43.667855, -79.807028	-	-	-	-	-
13c	Unnamed Springbrook Creek tributary	43.663061, -79.791961	-	-	-	-	-
13c	Unnamed Springbrook Creek tributary	43.657111, -79.791766	-	-	-	-	-
13c	Churchville Tributary (tributary of Credit River)	43.668650, -79.791280	43.657448, -79.762561	-	-	-	-
13c	Levi’s Creek (Credit River tributary)	43.634437, -79.828216	-	-	-	-	-
13c	Unnamed Credit River tributary	43.614088, -79.728043	-	-	-	-	-
13c	Fletcher’s Creek (tributary of Credit River)	43.709164, -79.816539	-	-	-	-	-
13c	Unnamed Fletcher’s Creek tributary	43.701567, -79.828334	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
13c	Unnamed Fletcher's Creek tributary	43.696111, -79.813582	-	-	-	-	-
13c	Unnamed Fletcher's Creek tributary	43.692864, -79.831577	-	-	-	-	-
13c	Unnamed Fletcher's Creek tributary	43.688233, -79.792390	-	-	-	-	-
14a	West Humber River	43.758399, -79.678536	43.833274, -79.779900	-	-	-	-
14a	Lindsay Creek (West Humber River tributary)	43.851457, -79.772736	-	-	-	-	-
14a	Salt Creek (tributary of West Humber River)	43.824420, -79.813633	-	-	-	-	-
14a	Unnamed West Humber River tributary	43.811685, -79.827648	-	-	-	-	-
14a	Unnamed West Humber River tributary	43.804494, -79.817108	-	-	-	-	-
14a	Unnamed West Humber River tributary	43.784906, -79.789961	-	-	-	-	-
14a	Kilmanagh Creek (West Humber River tributary)	43.77168, -79.846516	-	-	-	-	-
14a	Unnamed West Humber River tributary	43.767276, -79.730060	-	-	-	-	-
14a	Unnamed West Humber River tributary	43.748987, -79.645939	43.797255, -79.682092	-	-	-	-
14b	Humber River	43.879554, -79.742464	43.967405, -79.894631	-	-	-	-
14b	Unnamed Humber River tributary	43.907966, -79.808521	-	-	-	-	-
14c	East Humber River	43.788219, -79.589925	43.947782, -79.487837	-	-	-	-
14c	Unnamed East Humber River tributary	43.945117, -79.515902	-	-	-	-	-
14c	Unnamed East Humber River tributary	43.932073, -79.633736	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
14c	Unnamed East Humber River tributary	43.918665, -79.643572	-	-	-	-	-
14c	Unnamed East Humber River tributary	43.896631, -79.651246	-	-	-	-	-
14c	Purpleville Creek (East Humber River tributary)	43.858908, -79.615001	43.855723, -79.604874	43.864778, -79.589547	43.877752, -79.569552	43.884798, -79.559424	43.877276, -79.556048
14c	Unnamed East Humber River tributary	43.830141, -79.600077	-	-	-	-	-
14c	Marigold Creek (tributary of East Humber River)	43.836111, -79.585517	43.830909, -79.584344	-	-	-	-
15	Don River East Branch	43.824646, -79.437501	43.850441, -79.471430	43.871519, -79.488072	43.882134, -79.476912	43.875816, -79.452513	-
16	Rouge River	43.865658, -79.306025	43.935257, -79.409633	-	-	-	-
16	Unnamed Rouge River tributary	43.918784, -79.410691	-	-	-	-	-
16	Unnamed Rouge River tributary	43.891960, -79.421539	-	-	-	-	-
16	Bruce Creek (Rouge River tributary)	43.870632, -79.313175	43.874483, -79.318374	43.948055, -79.353254	-	-	-
16	Unnamed Bruce Creek tributary	43.913706, -79.335678	-	-	-	-	-
16	Berczy Creek (Bruce Creek tributary)	43.874483, -79.318374	43.942727, -79.386352	-	-	-	-
16	Unnamed Berczy Creek tributary	43.885232, -79.366842	-	-	-	-	-
16	Robinson Creek (Rouge River tributary)	43.869606, -79.260739	43.906432, -79.299983	-	-	-	-
16	Morningside Creek (Rouge River tributary)	43.814580, -79.185714	43.847832, -79.244499	-	-	-	-
16	Little Rouge Creek (Rouge River tributary)	43.919180, -79.261458	43.952561, -79.312861	-	-	-	-
16	Unnamed Little Rouge Creek tributary	43.984671, -79.256379	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
16	Unnamed Little Rouge Creek tributary	43.985582, -79.276414	-	-	-	-	-
16	Unnamed Little Rouge Creek tributary	43.975842, -79.282848	-	-	-	-	-
16	Unnamed Little Rouge Creek tributary	43.955359, -79.253557	-	-	-	-	-
16	Unnamed Little Rouge Creek tributary	43.939864, -79.250075	-	-	-	-	-
17	Duffins Creek	43.848661, -79.056243	43.906631, -79.068193	43.985204, -79.080111	-	-	-
17	Michell Creek (tributary of Duffins Creek)	43.978867, -79.156830	-	-	-	-	-
17	Unnamed Michell Creek tributary	43.974263, -79.143624	-	-	-	-	-
17	Unnamed Michell Creek tributary	43.980548, -79.152361	-	-	-	-	-
17	Unnamed Michell Creek tributary	43.981684, -79.134664	-	-	-	-	-
17	Brougham Creek (tributary of Duffins Creek)	43.906631, -79.068193	-	-	-	-	-
17	Unnamed Brougham Creek tributary	43.934371, -79.086324	-	-	-	-	-
17	Urfe Creek (tributary of Duffins Creek)	43.914008, -79.118972	-	-	-	-	-
17	Unnamed Urfe Creek tributary	43.888894, -79.076247	-	-	-	-	-
17	Ganatsekiagon Creek (tributary of Urfe Creek)	43.894832, -79.128553	-	-	-	-	-
17	Unnamed Ganatsekiagon Creek tributary	43.899267, -79.109309	-	-	-	-	-
17	Unnamed Ganatsekiagon Creek tributary	43.897977, -79.115523	-	-	-	-	-
17	Unnamed Ganatsekiagon Creek tributary	43.880245, -79.111923	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
17	Carruthers Creek	43.903198, -79.018774	43.948519, -79.042319	-	-	-	-
17	Unnamed Carruthers Creek tributary	43.949819, -79.066059	-	-	-	-	-
17	Unnamed Carruthers Creek tributary	43.952042, -79.058417	-	-	-	-	-
17	Lynde Creek	43.878426, -78.961698	44.005824, -79.019737	-	-	-	-
17	Unnamed Lynde Creek tributary	43.986831, -78.975472	-	-	-	-	-
17	West Lynde Creek (Lynde Creek tributary)	43.993333, -79.048105	43.993773, -79.033634	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.963197, -79.010605	-	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.957212, -79.020900	-	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.973502, -78.991735	-	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.965500, -78.992546	-	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.937342, -78.986625	-	-	-	-	-
17	Unnamed West Lynde Creek tributary	43.924777, -78.983111	-	-	-	-	-
18	Unnamed South Holland Canal tributary	44.038998, -79.583828	44.014748, -79.588527	-	-	-	-
18	Kettleby Creek (tributary of the South Holland Canal)	44.044280, -79.573755	44.007192, -79.525991	-	-	-	-
18	Unnamed Kettleby Creek tributary	43.993620, -79.546959	-	-	-	-	-
18	Unnamed Kettleby Creek tributary	43.985488, -79.559807	-	-	-	-	-
18	Unnamed Kettleby Creek tributary	43.993025, -79.568784	-	-	-	-	-

Figure #	Location	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
18	Unnamed Kettleby Creek tributary	44.003157, -79.574004	-	-	-	-	-
18	Unnamed Kettleby Creek tributary	44.001618, -79.568704	-	-	-	-	-

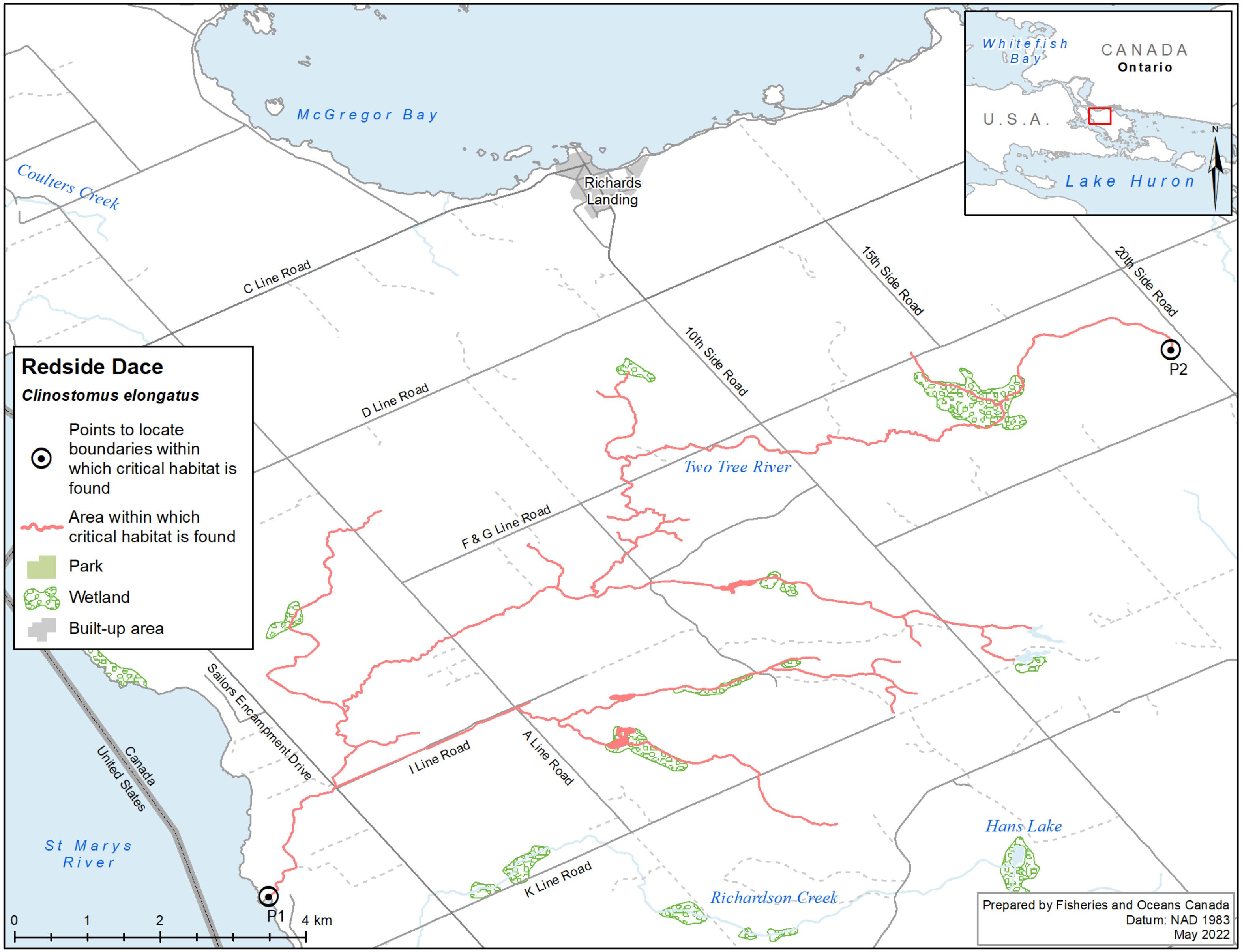

Figure 5. Bounding box within which critical habitat is found for Redside Dace in the Two Tree River watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

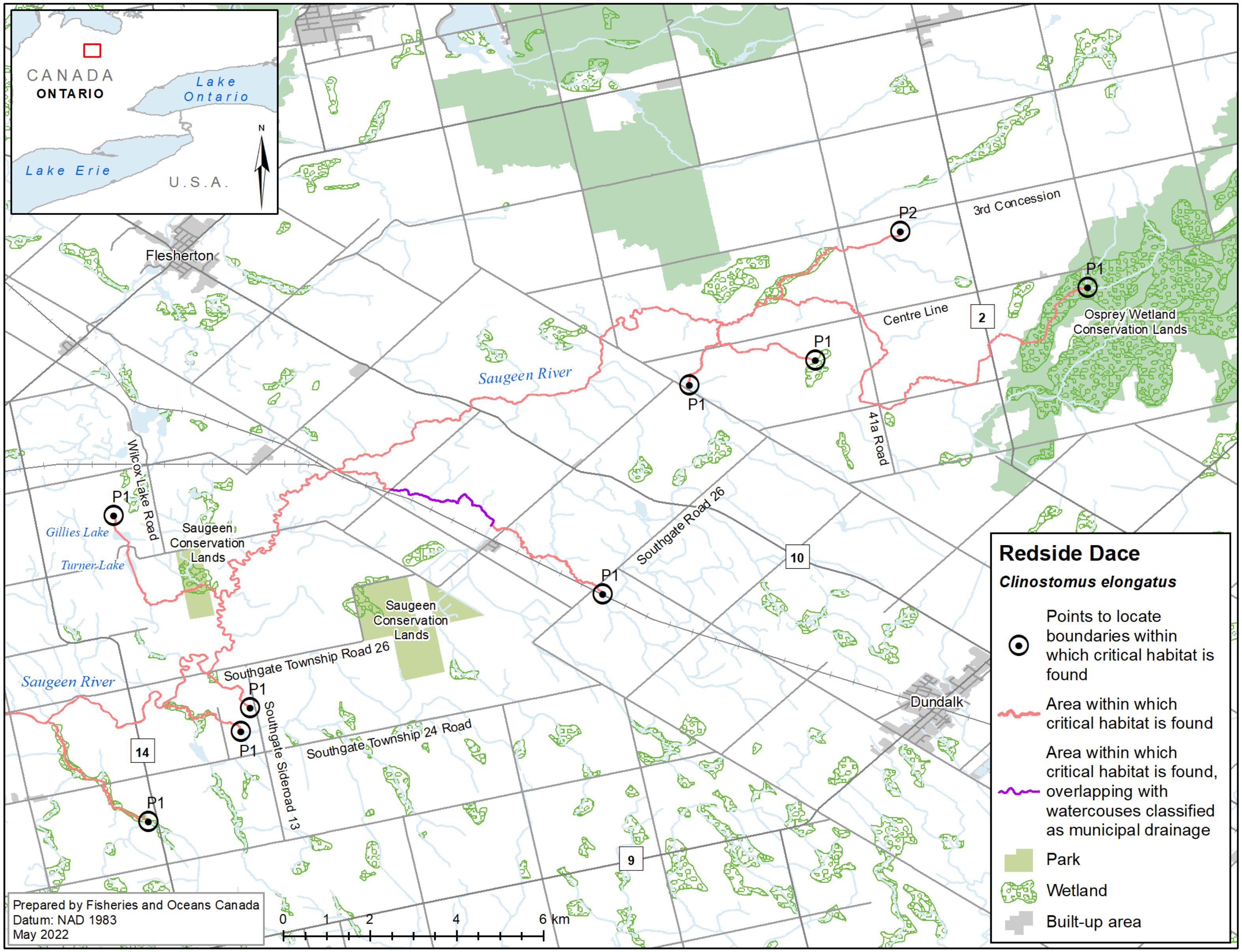

Figure 6(a). Bounding box within which critical habitat is found for Redside Dace in the Saugeen River watershed (eastern portion). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

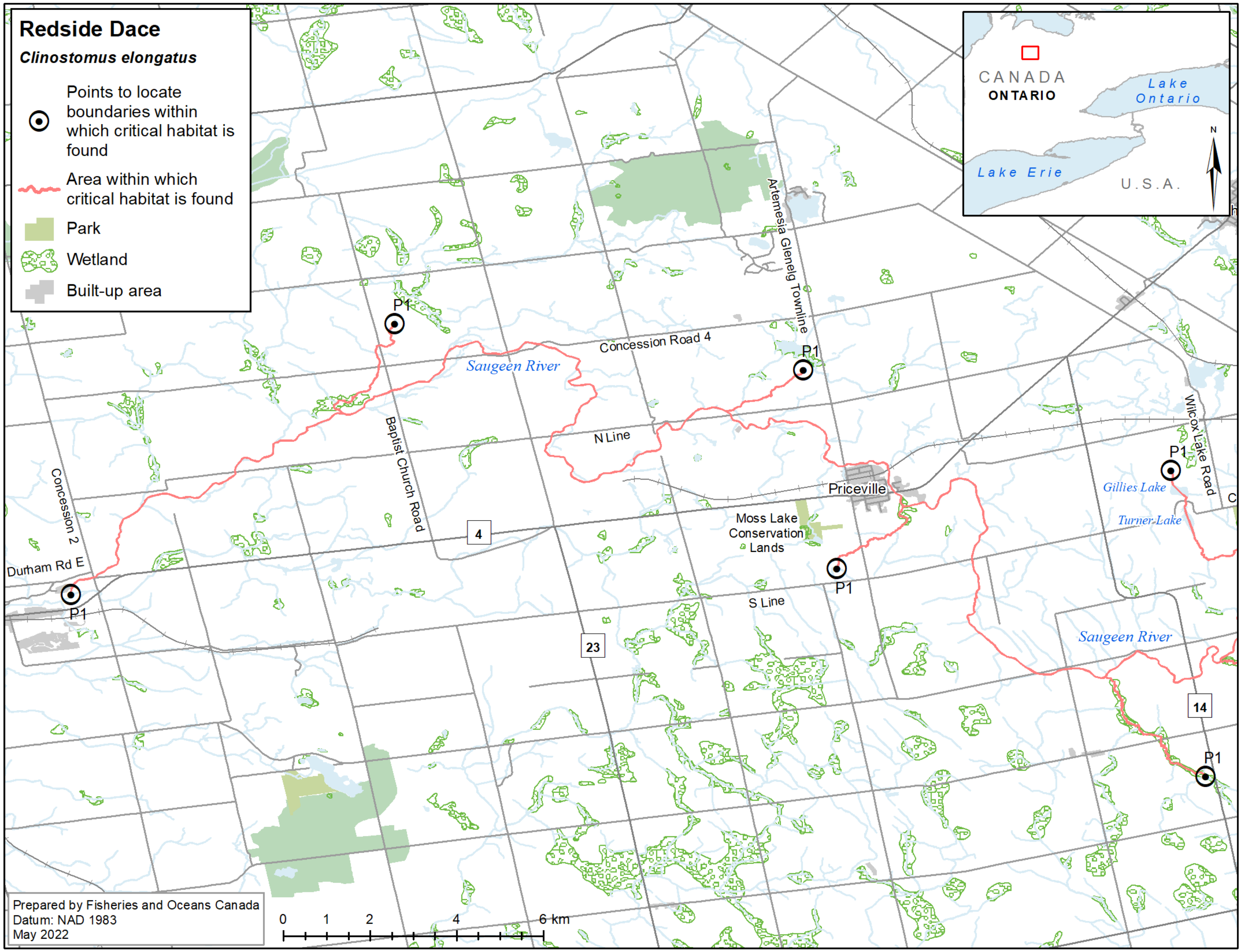

Figure 6(b). Bounding box within which critical habitat is found for Redside Dace in the Saugeen River watershed (western portion). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

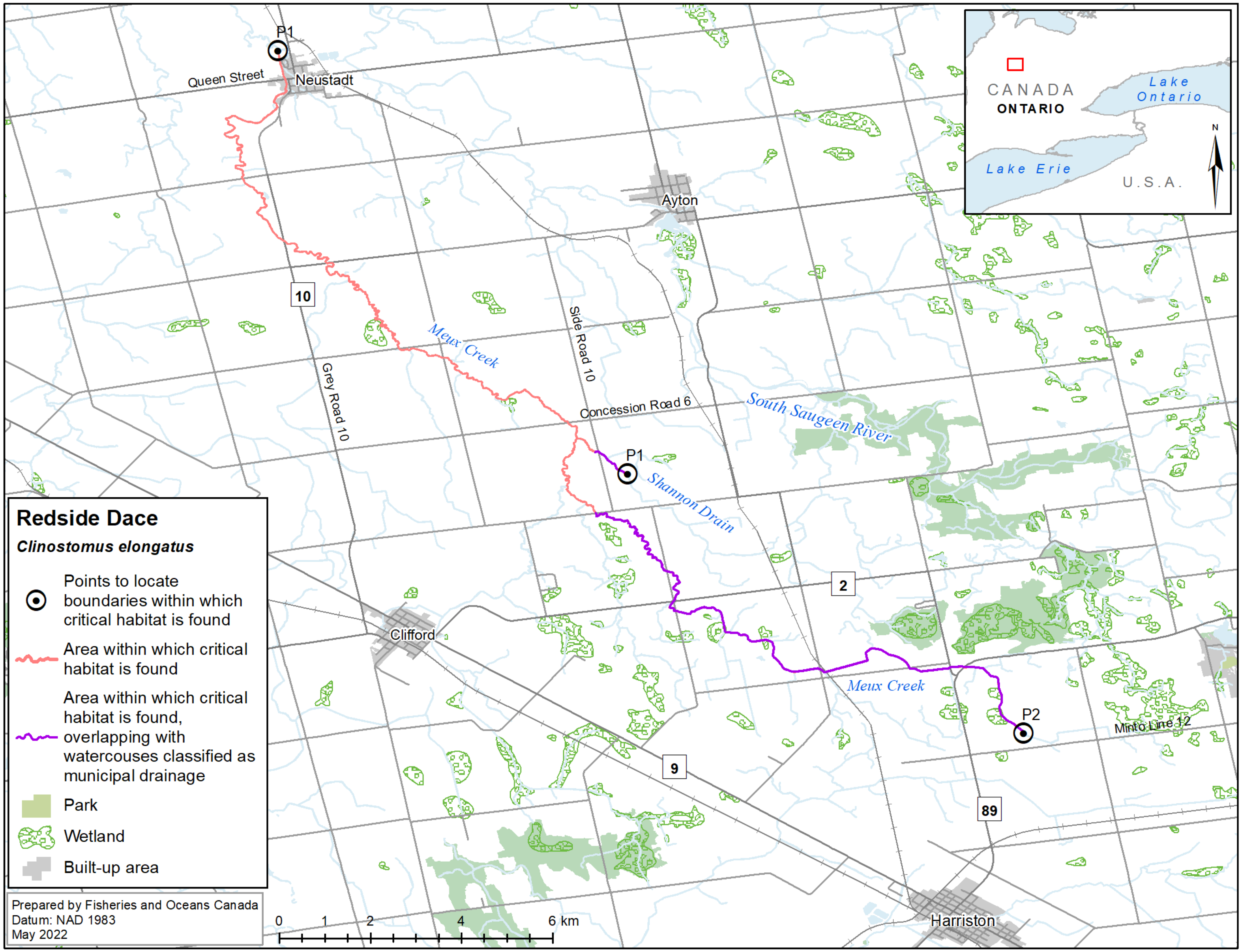

Figure 6(c). Bounding box within which critical habitat is found for Redside Dace in Meux Creek (Saugeen River). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

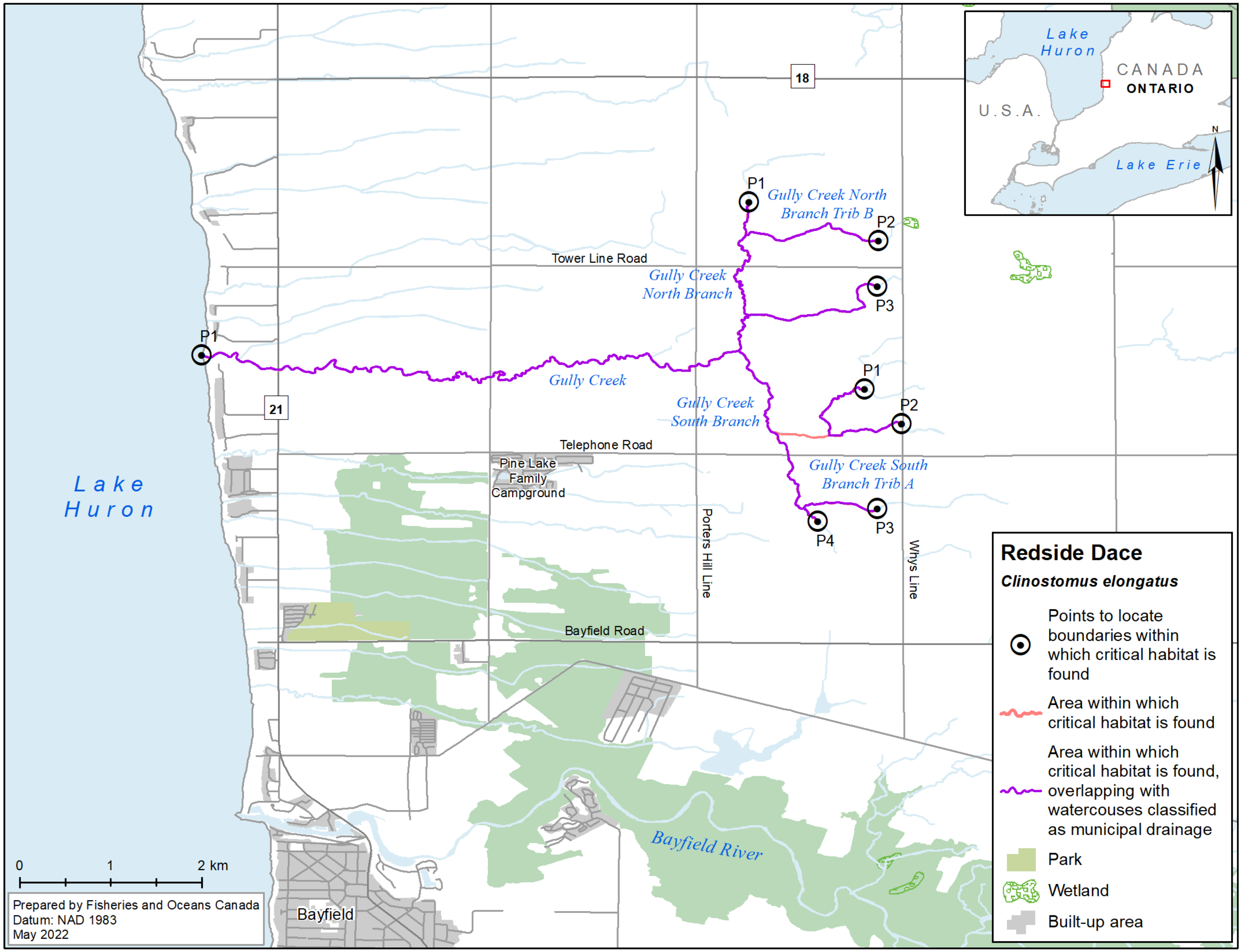

Figure 7. Bounding box within which critical habitat is found for Redside Dace in the Gully Creek watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

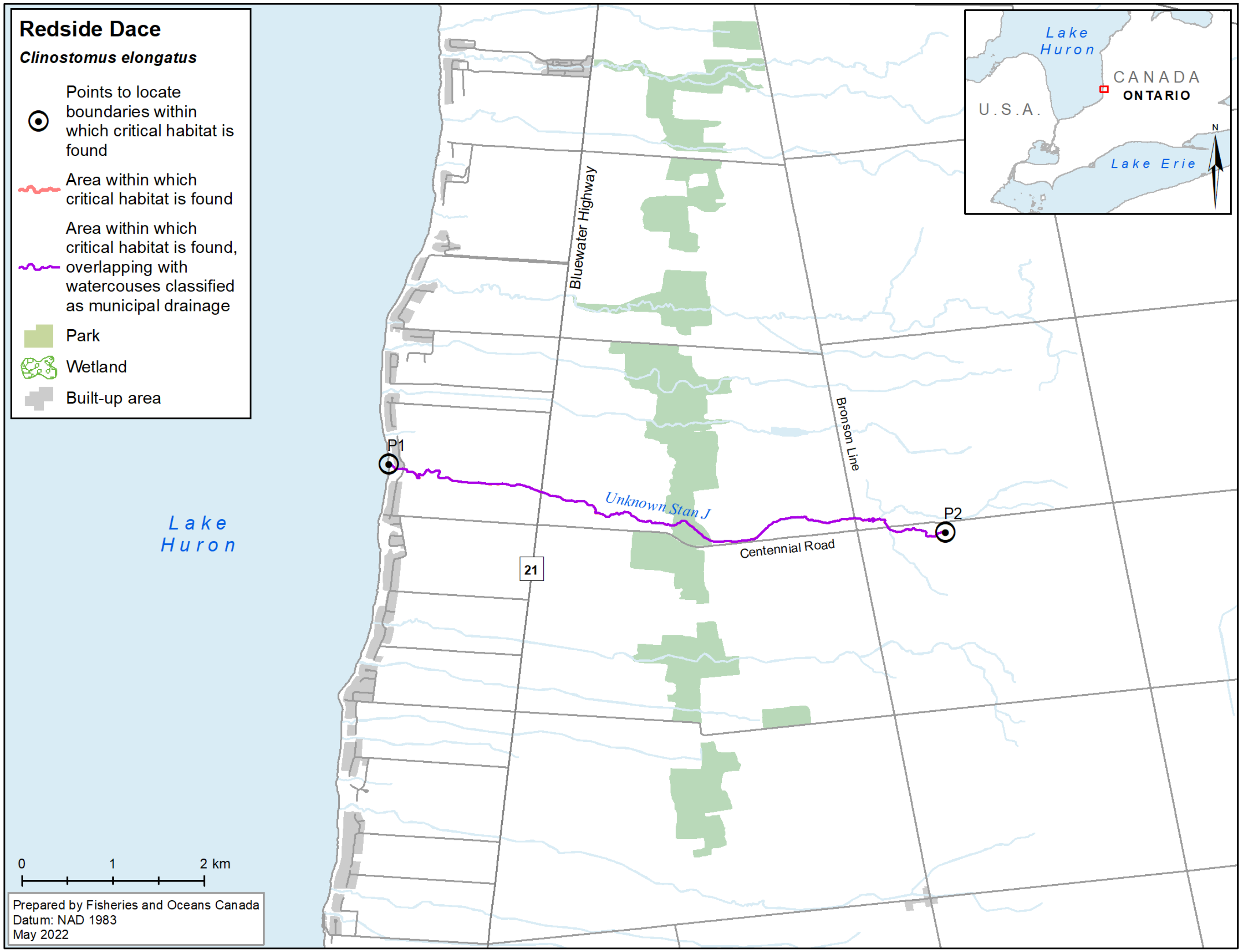

Figure 8. Bounding box within which critical habitat is found for Redside Dace in Unknown Stan J. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

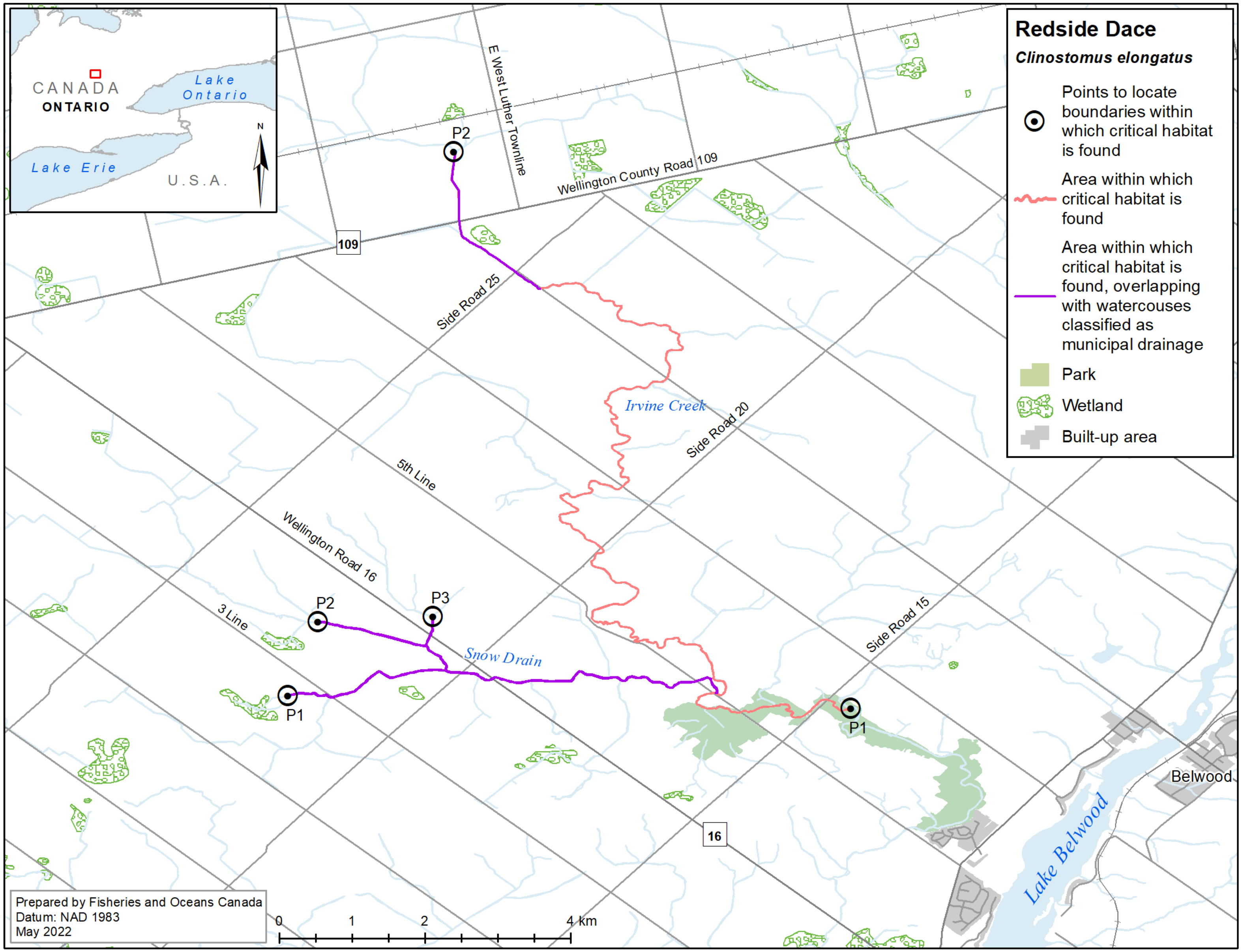

Figure 9. Bounding box within which critical habitat is found for Redside Dace in the Irvine Creek watershed (Grand River). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

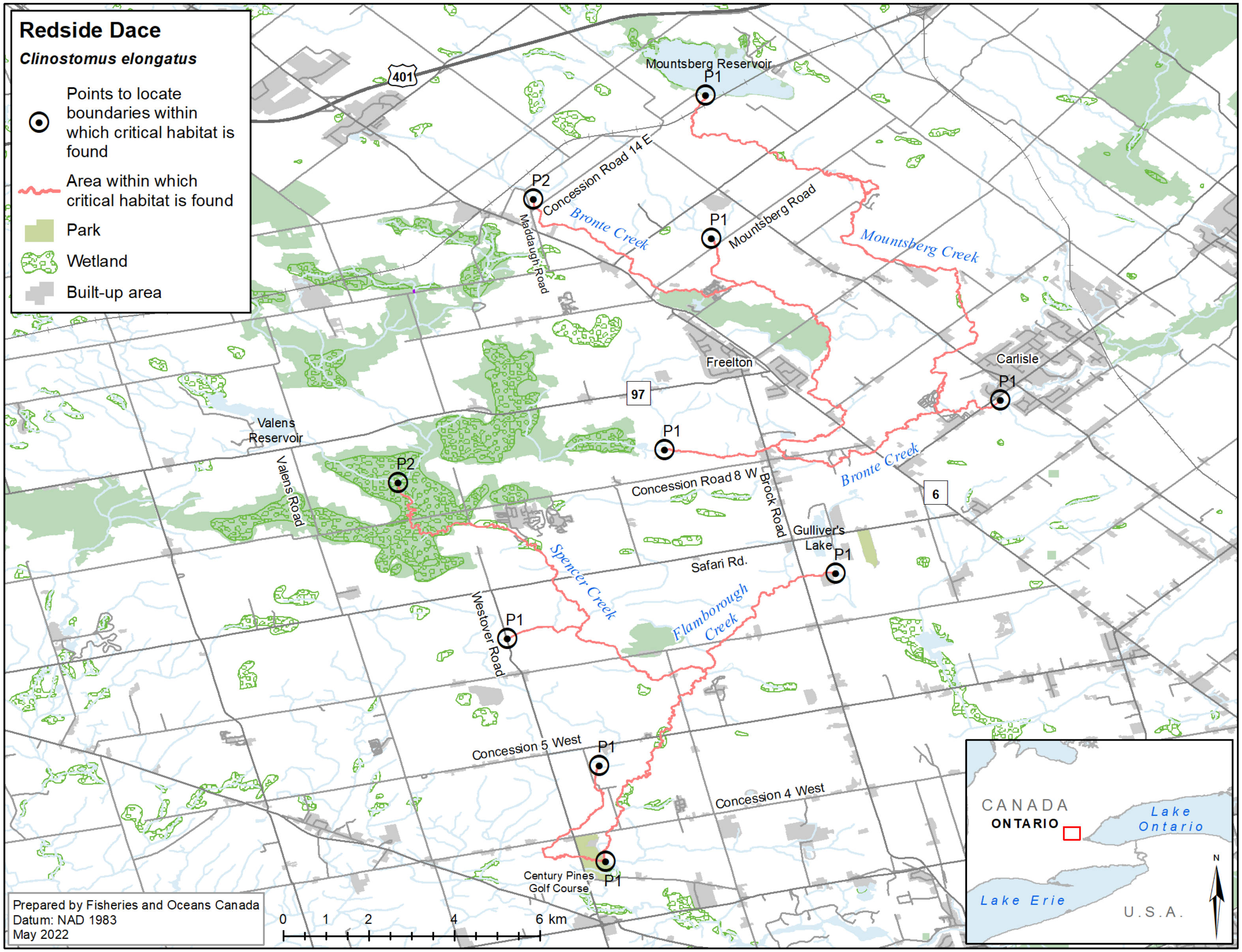

Figure 10. Bounding box within which critical habitat is found for Redside Dace in the Spencer and Bronte creek watersheds. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

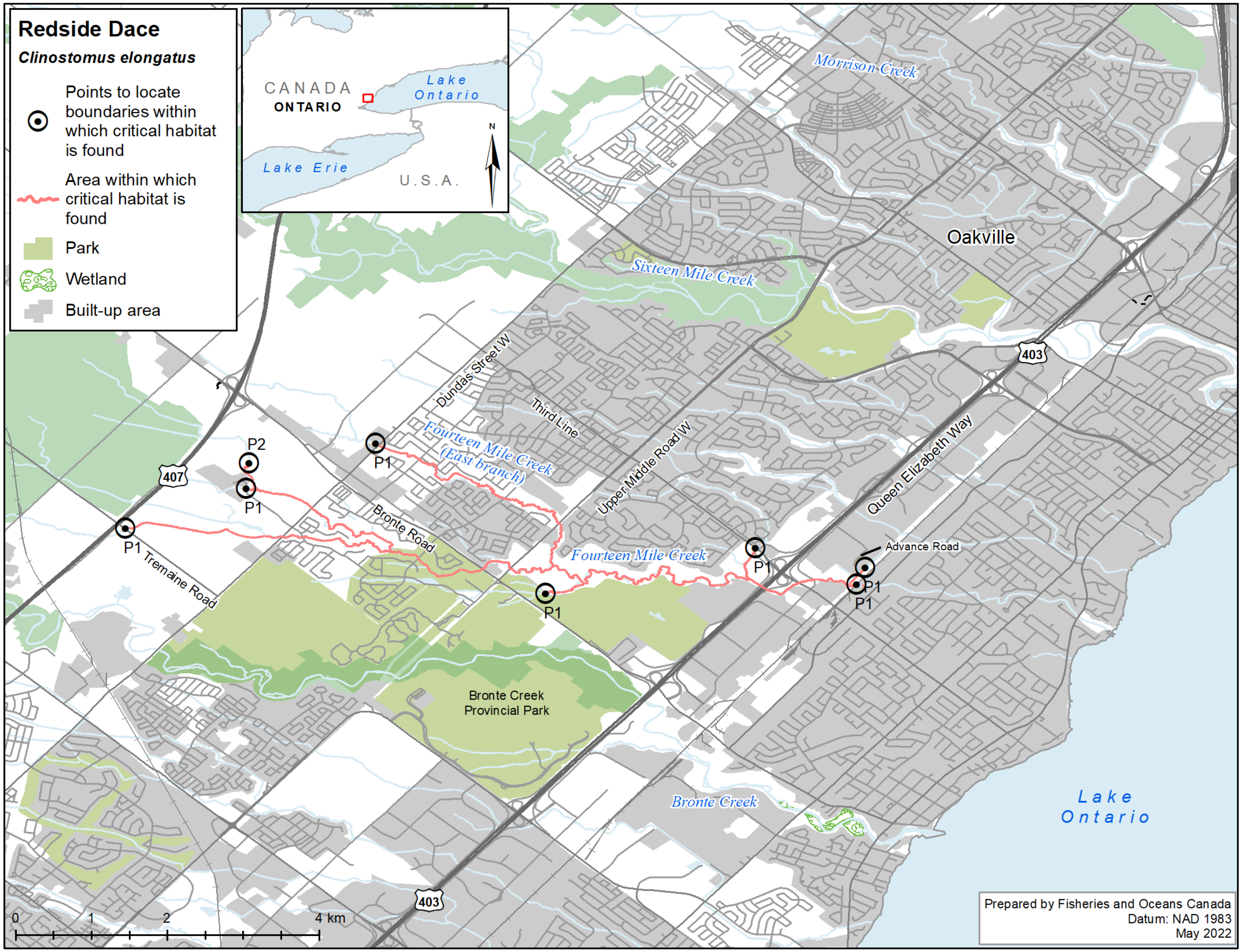

Figure 11. Bounding box within which critical habitat is found for Redside Dace in the Fourteen Mile Creek watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

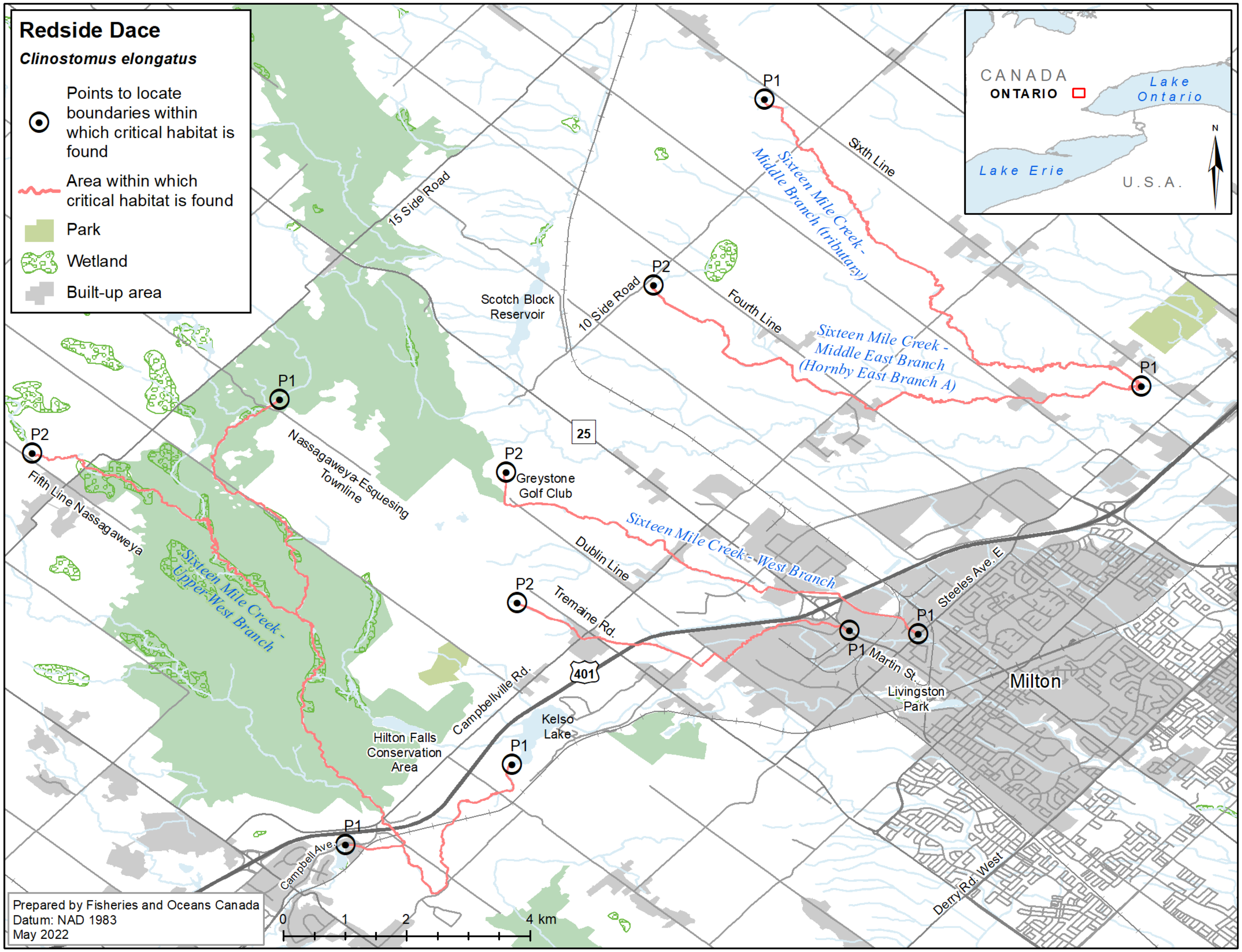

Figure 12. Bounding box within which critical habitat is found for Redside Dace in the Sixteen Mile Creek watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

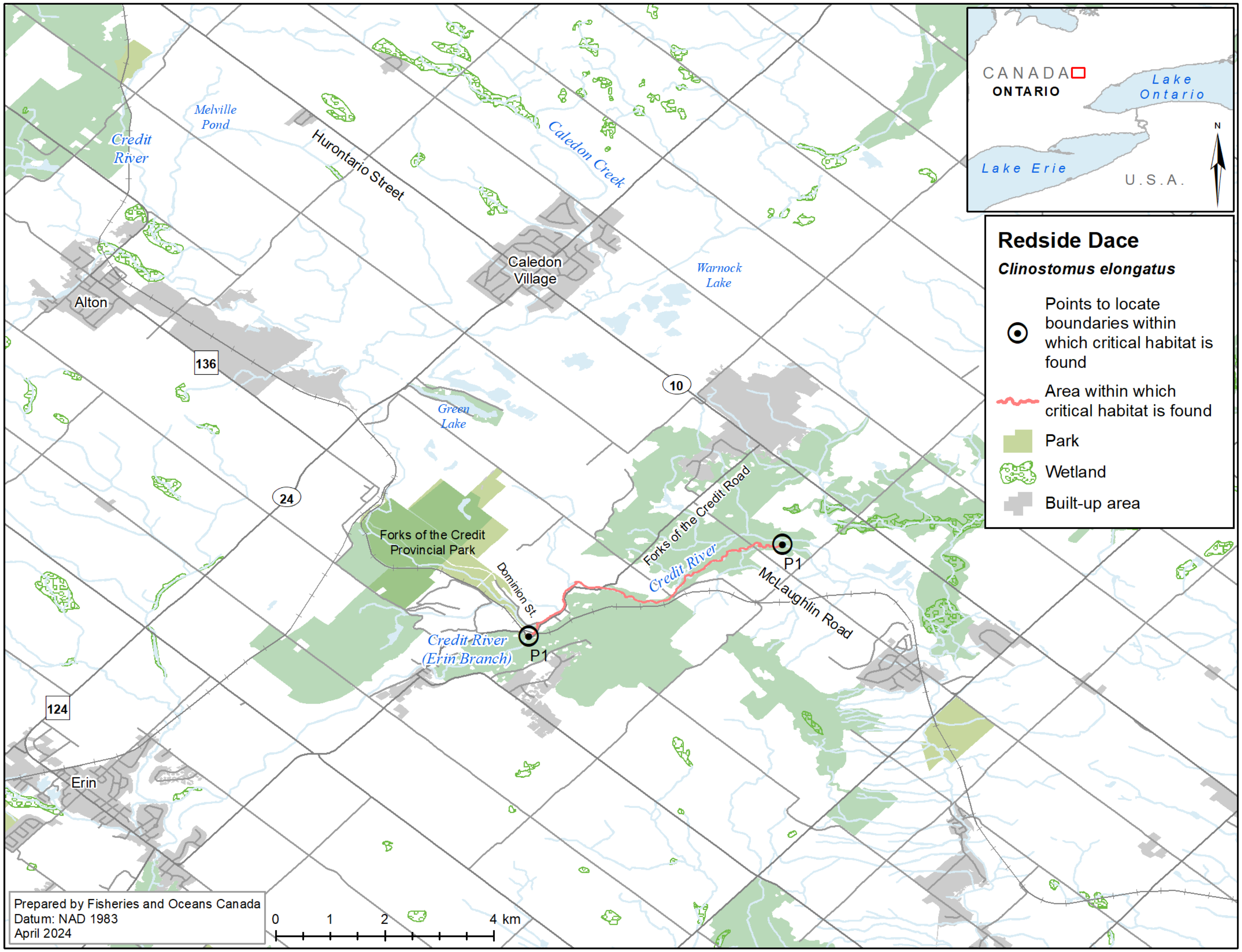

Figure 13(a). Bounding box within which critical habitat is found for Redside Dace in the Credit River watershed (upper portion). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

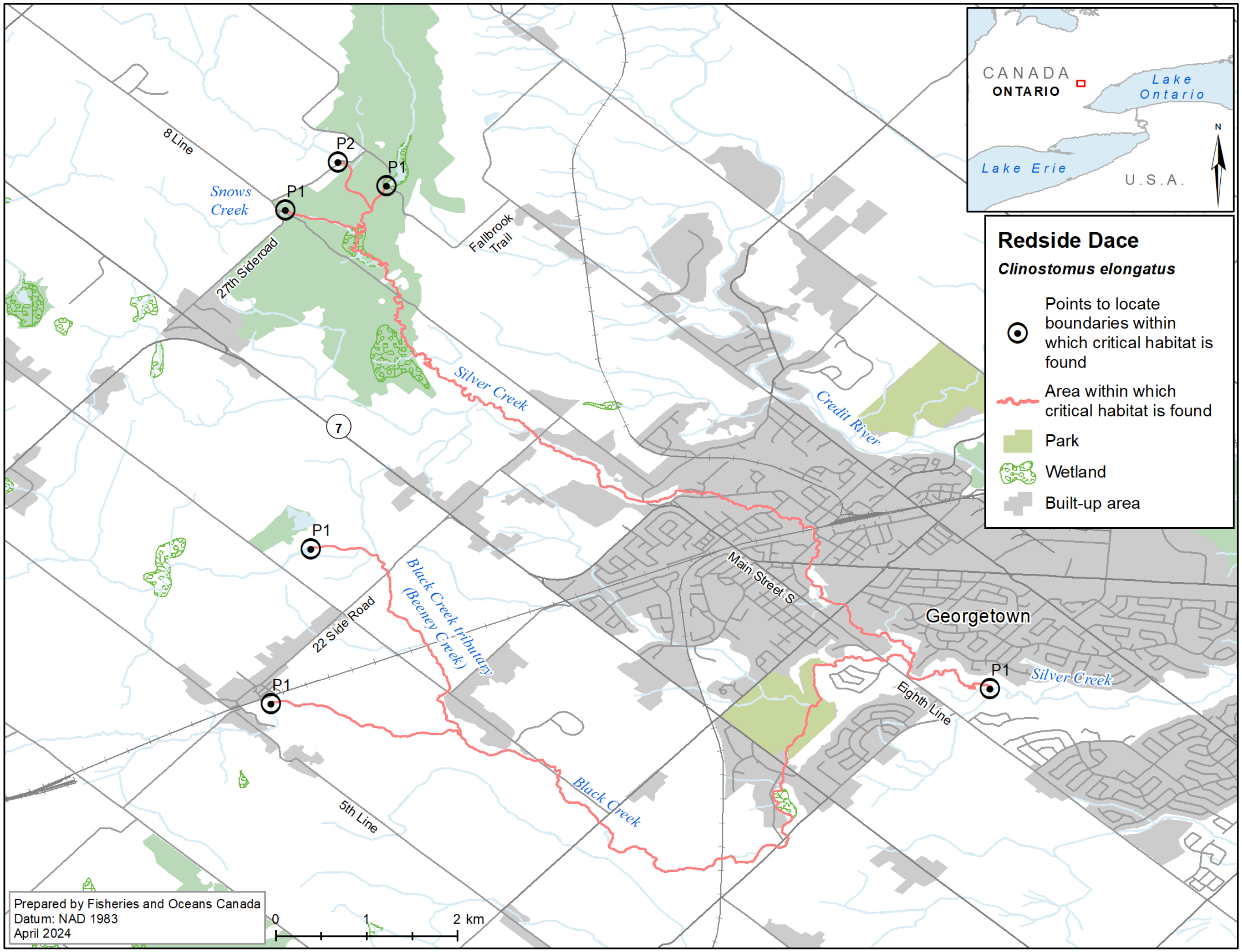

Figure 13(b). Bounding box within which critical habitat is found for Redside Dace in the Silver and Snows creek watersheds (Credit River West Branch). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

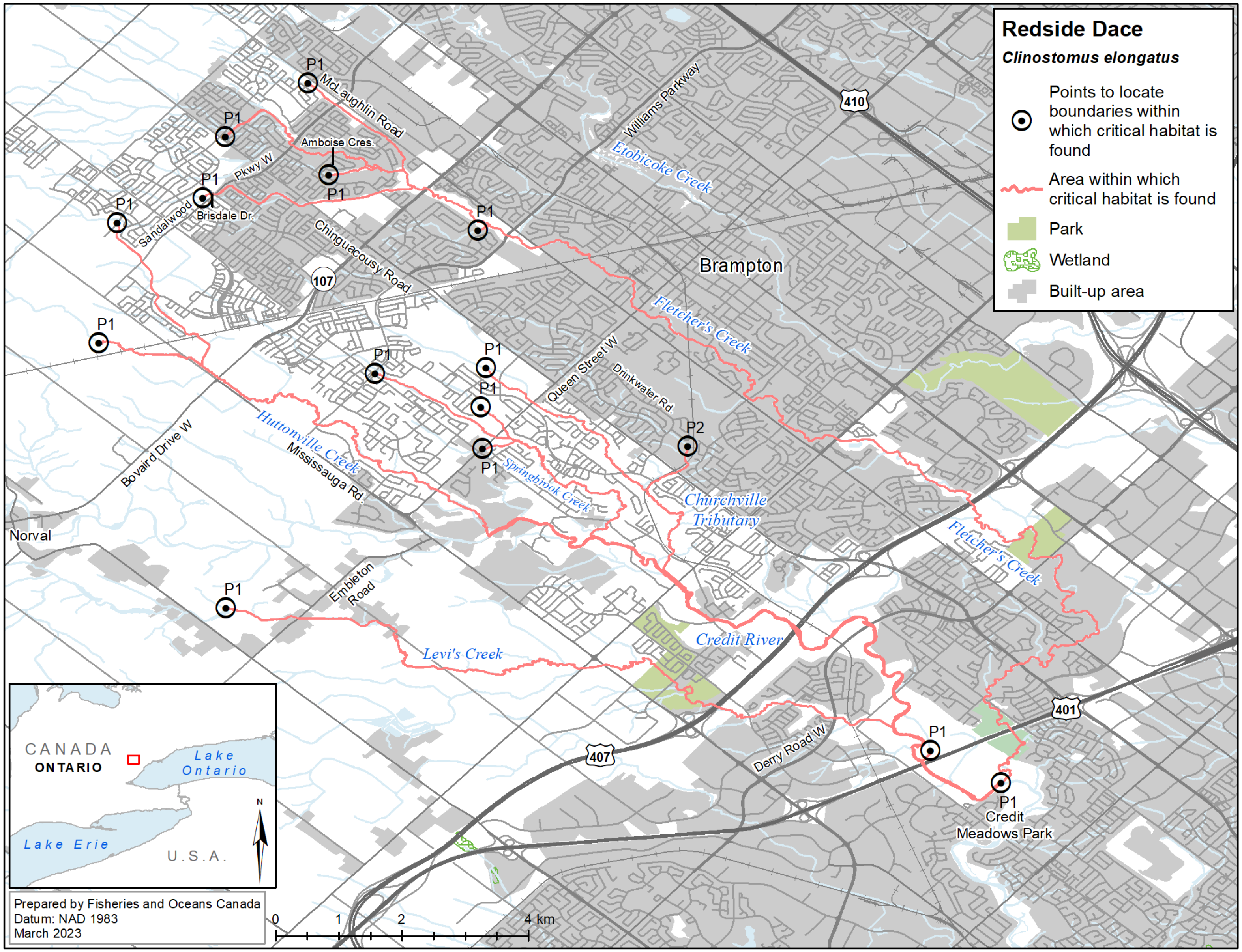

Figure 13(c). Bounding box within which critical habitat is found for Redside Dace in the Credit River watershed (lower portion). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

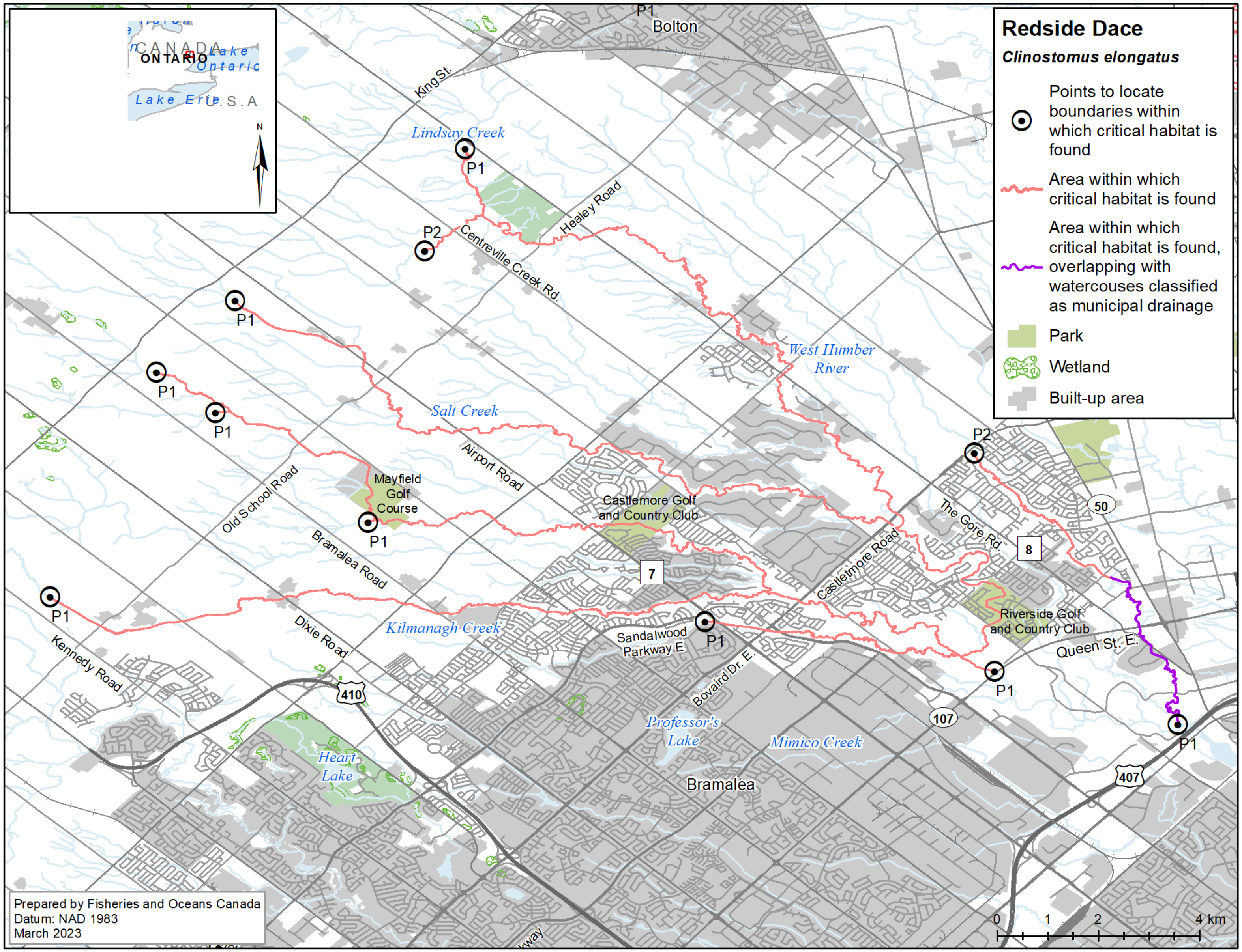

Figure 14(a). Bounding box within which critical habitat is found for Redside Dace in the West Humber River watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

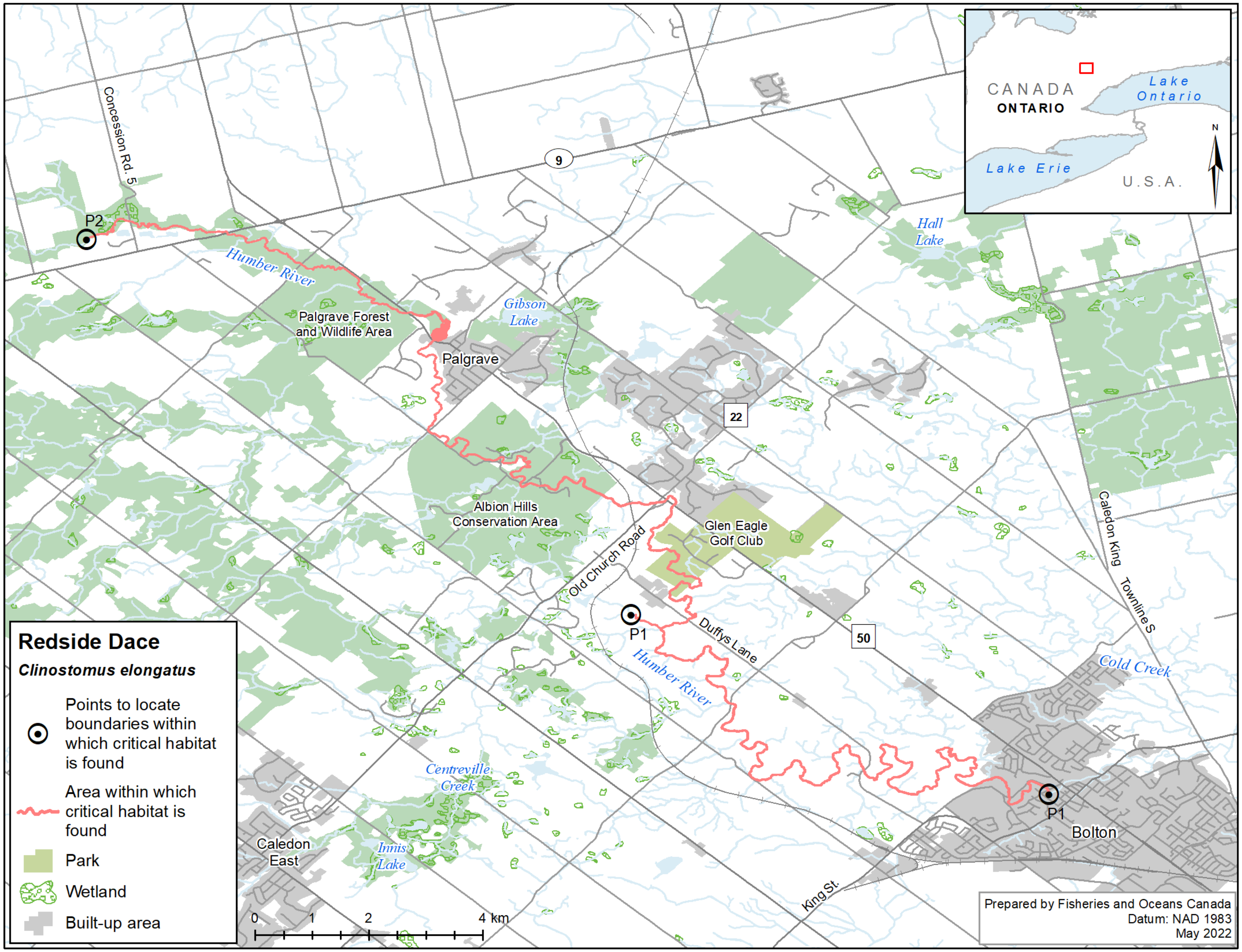

Figure 14(b). Bounding box within which critical habitat is found for Redside Dace in the Humber River watershed (upper portion). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

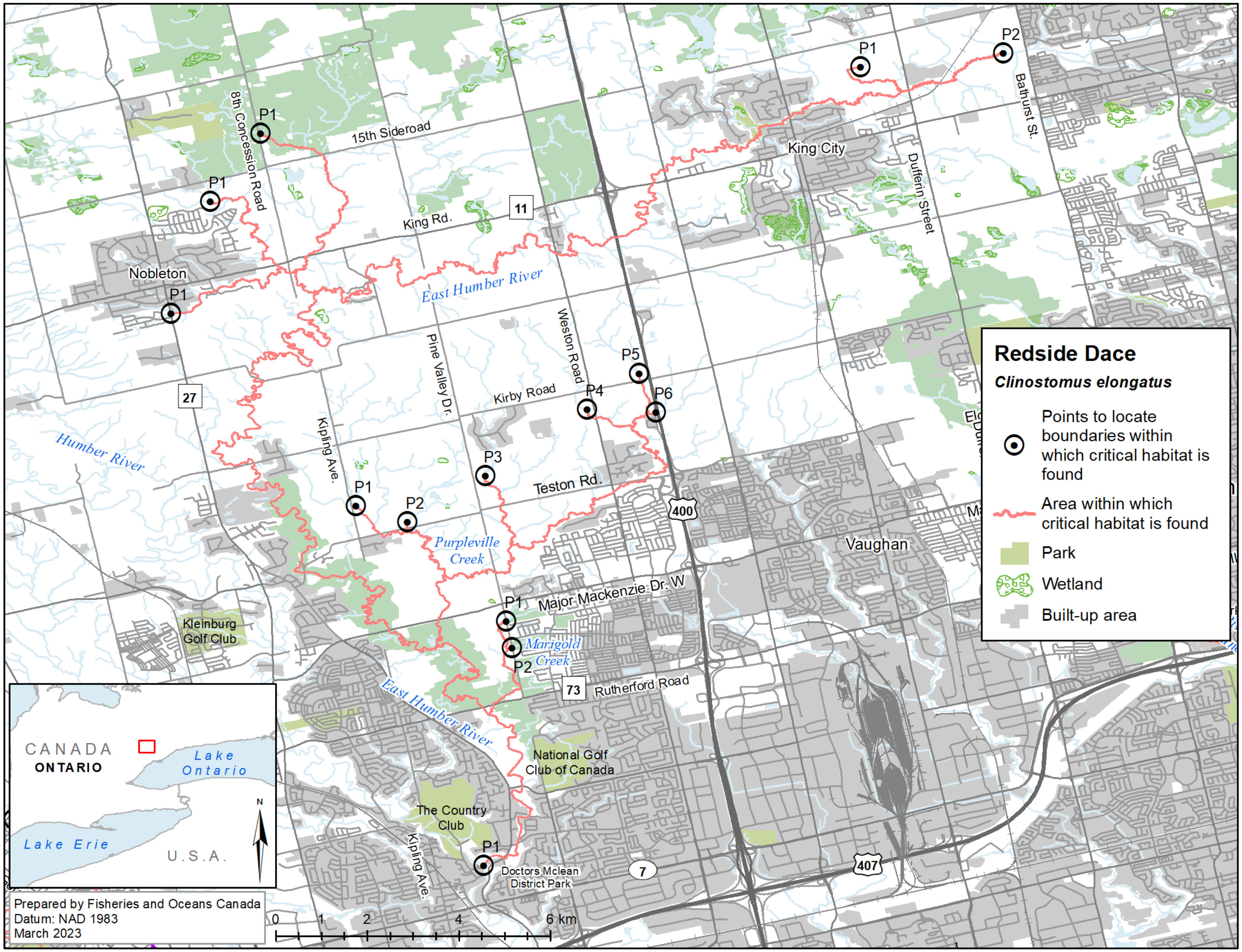

Figure 14(c). Bounding box within which critical habitat is found for Redside Dace in the East Humber River watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

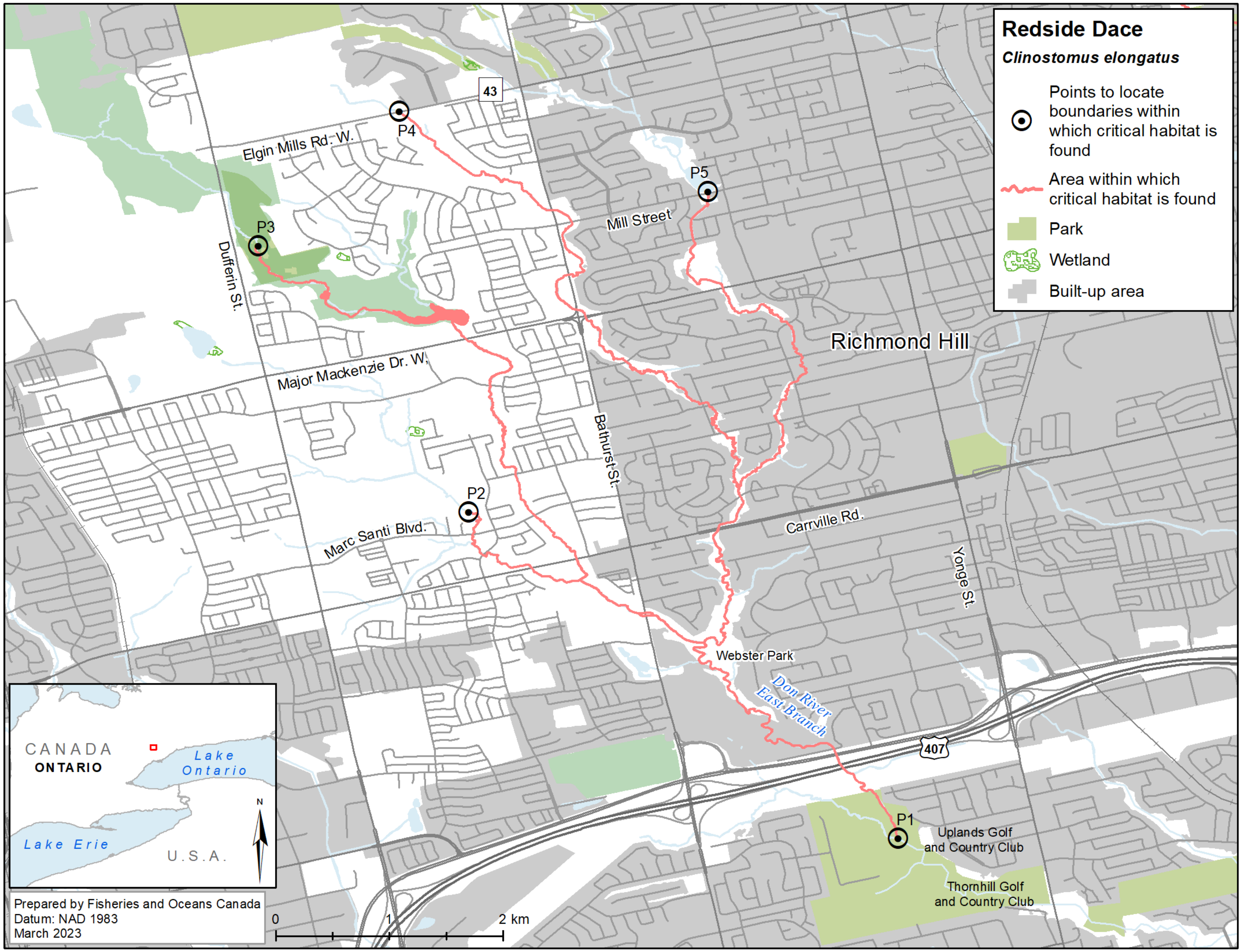

Figure 15. Bounding box within which critical habitat is found for Redside Dace in the Don River watershed (East Branch). Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

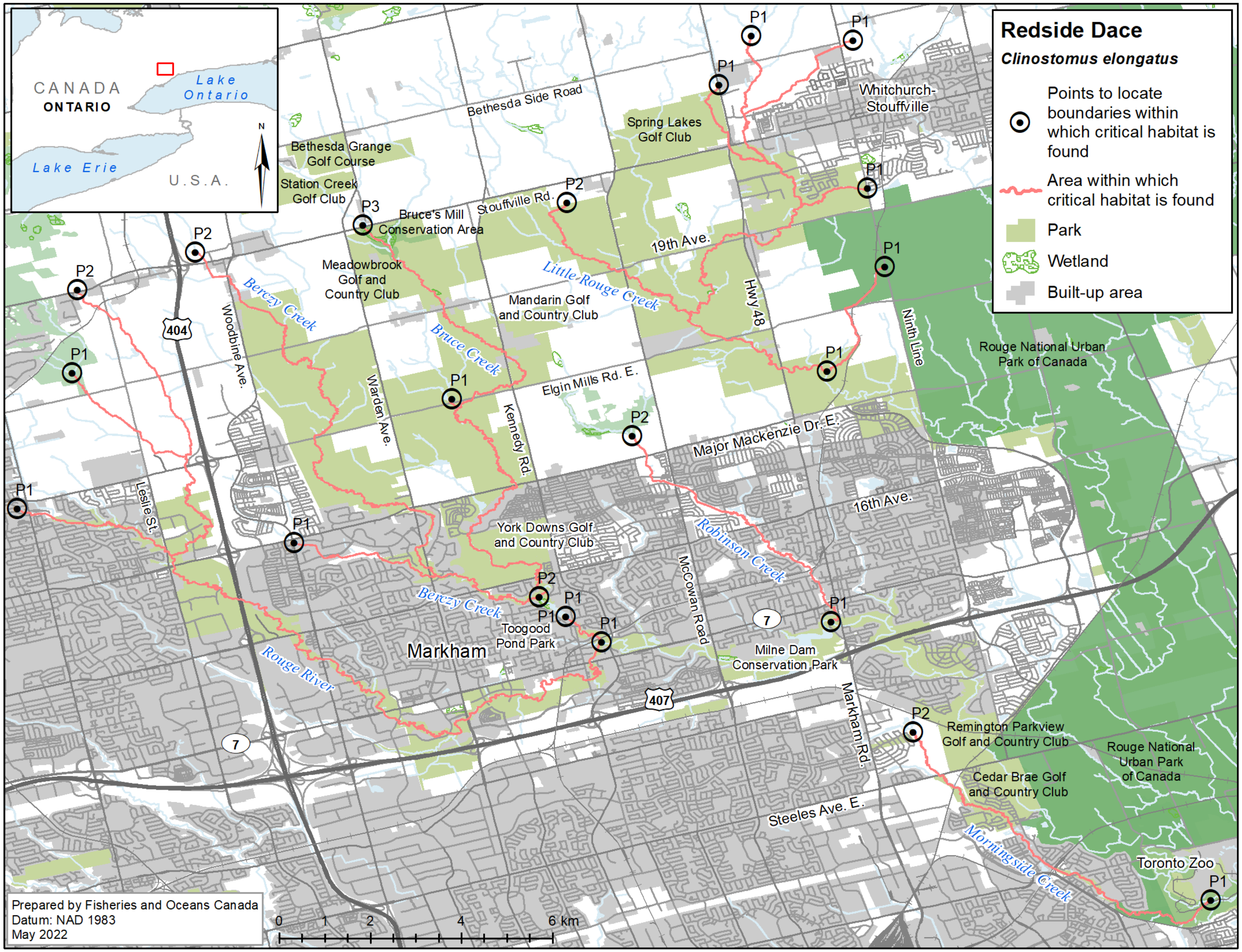

Figure 16. Bounding box within which critical habitat is found for Redside Dace in the Rouge River watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

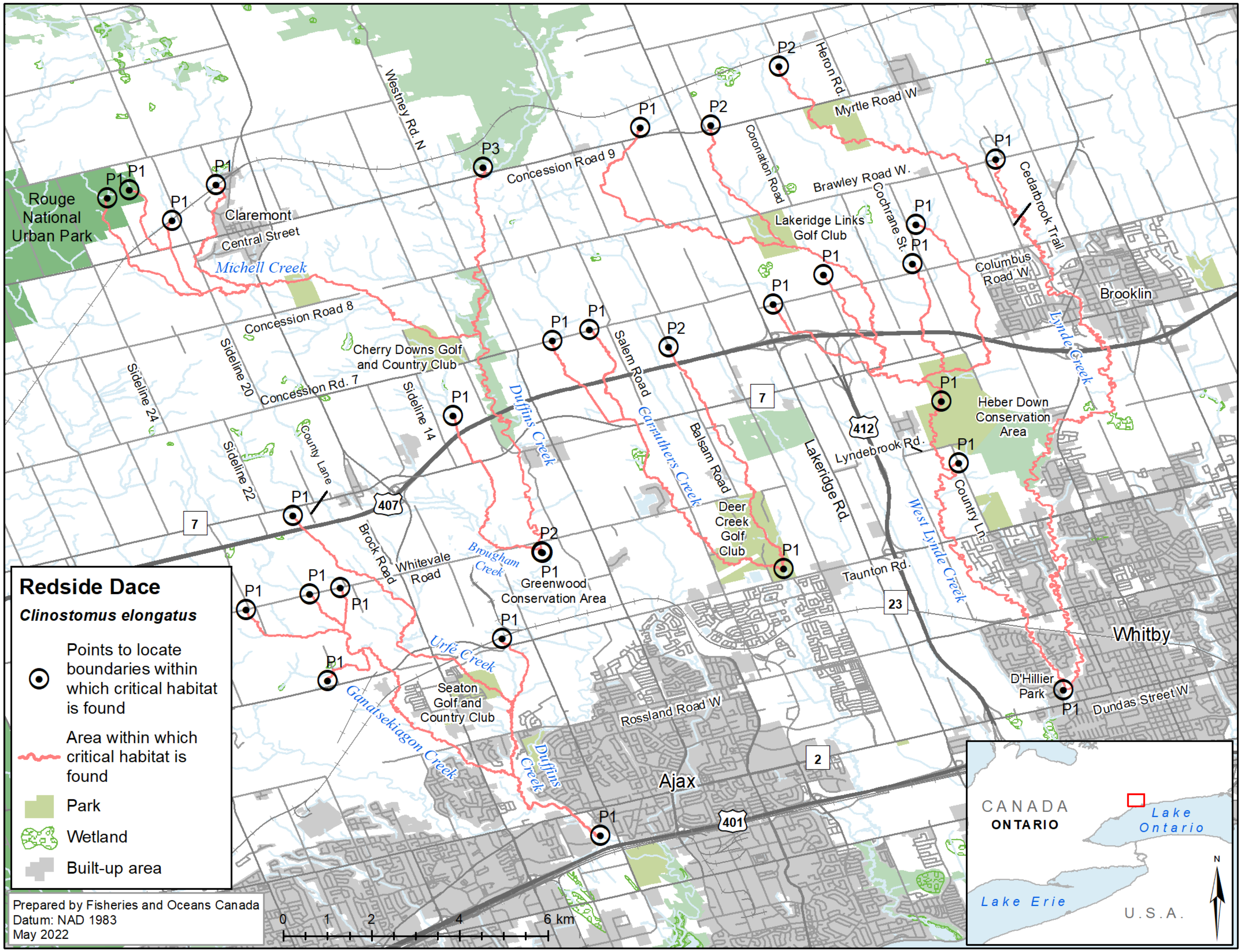

Figure 17. Bounding box within which critical habitat is found for Redside Dace in the Duffins, Carruthers, and Lynde creeks watersheds. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

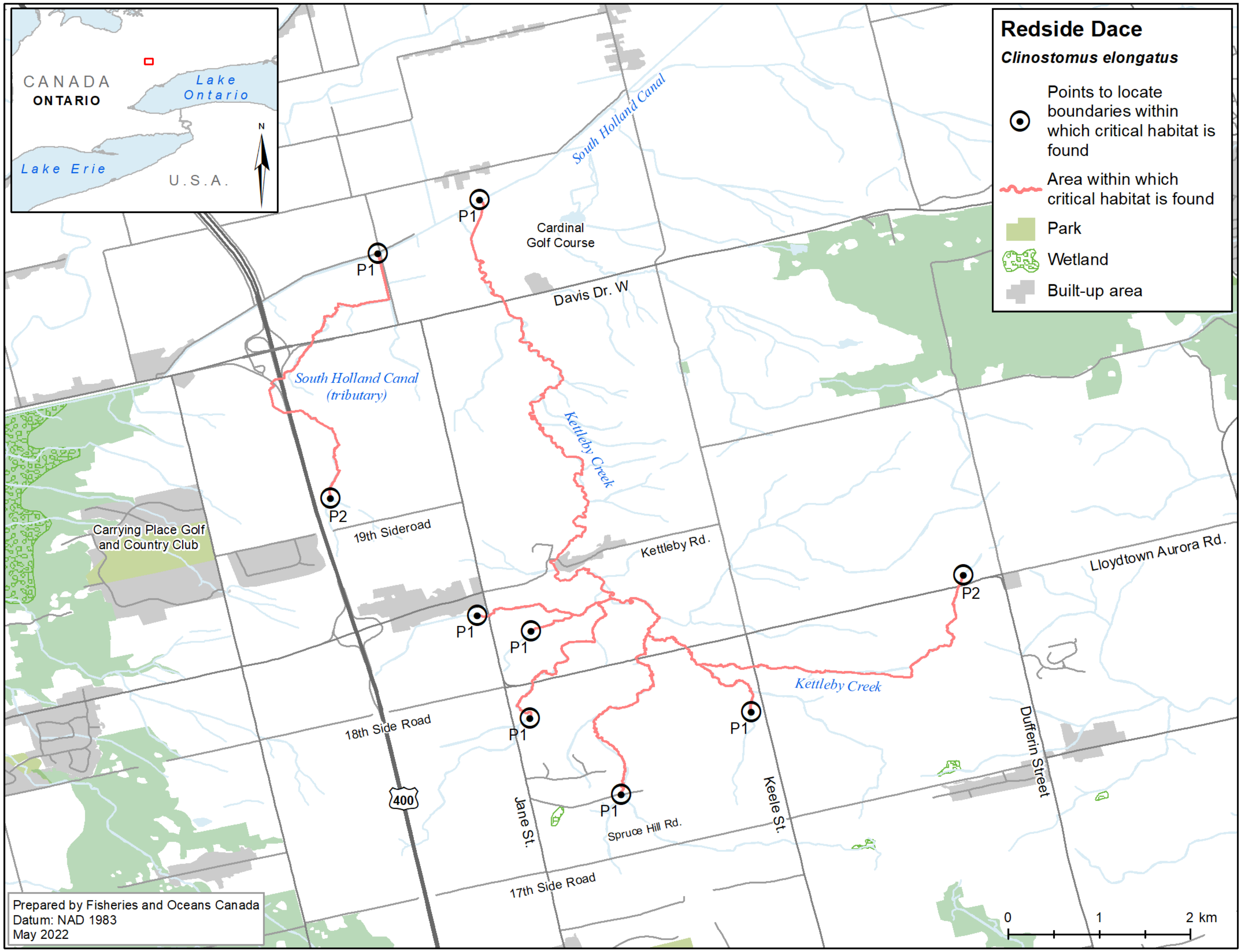

Figure 18. Bounding box within which critical habitat is found for Redside Dace in the Holland River watershed. Note that critical habitat does not comprise all areas within the bounding box, but only those areas within the identified geographical boundaries where the described biophysical feature(s) and the function(s) it supports occur, as described in table 9.

Biophysical functions, features, and attributes

Table 9 summarizes the best available knowledge of the features and attributes of critical habitat necessary to support the life-cycle functions for each life stage of the Redside Dace (refer to section 3.3 Needs of the Redside Dace for full references). Note that not all attributes in table 9 must be present for a feature to be identified as critical habitat. If the features as described in table 9 are present and capable of supporting the associated function(s), the feature is considered critical habitat for the species, even though some of the associated attributes might be outside of the range indicated in the table. All attributes may be used to help inform management decisions for the recovery and/or protection of habitat.

Studies to further refine knowledge on the essential features and attributes of critical habitat that support the life-cycle functions for various life stages of the Redside Dace are described in section 7 (Broad strategies and general approaches to meet objectives).

Table 9. General summary of the biophysical features and attributes of critical habitat that support the life-cycle functions for each life stage of the Redside Dace. Note that not all attributes must be present for a feature to be identified as critical habitat.

Life stage	Function[25]	Feature(s)[26]	Attribute(s)[27]
Spawn to hatch (usually May)	Spawning, cover, nursery	Reaches of streams containing both pool and riffle habitats, bankfull channel width	• Riffle areas with gravel substrates (< 60 mm particle size diameter) • Presence of Creek Chub and/or Common Shiner (Redside Dace typically spawns over nests constructed by these species) • Late spring water temperatures of 16 to 18°C (spawning activities initiate when these temperatures are reached) • Flow present in the watercourse at least 9 months of the year
Young of the year (YOY)	Feeding, cover, nursery	Reaches of streams containing both pool and riffle habitats, bankfull channel width	• No specific information is available regarding habitat requirements of larval or YOY, although YOY have been caught in similar habitats as adults and caught in intermittent channels upstream of spawning areas
Juvenile (age 1 until sexual maturity)	Feeding, cover	Reaches of streams containing both pool and riffle habitats, bankfull channel width	• Undercut banks and in-stream structure such as boulders and woody debris (preferred cover of the Redside Dace) • Summer wetted stream widths 0.5 to 20 m, depths 0.1 to 2 m • Substrates include boulders, sand, clay, silt, mud, gravel, and detritus • Relatively clear waters (preference for clear waters, but sometimes occur in moderate turbidity)

[25] Function: functions are life-cycle processes of the listed species taking place in critical habitat (for example, spawning, nursery, rearing, feeding and migration).

[26] Feature: each life-cycle function is supported by one or more features, which are the essential biophysical components of the critical habitat (for example, a redd). Features may change over time and usually consist of more than one part, or attribute. A change or disruption to the feature or any of its attributes may affect the function and its ability to meet the biological needs of the species.

[27] Attribute: attributes are measurable properties or characteristics of a feature. Attributes describe how the identified features support the identified functions necessary for the species' life processes.

Life stage	Function[25]	Feature(s)[26]	Attribute(s)[27]
			• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Deep pools (> 0.6 m depth) with little current (important as refugia for overwintering) • Adequate supply of overwinter prey species (aquatic insect larvae) • High contribution of ground water and stabilized flow conditions
Adult	Feeding, cover, winter refugia	Reaches of streams containing both pool and riffle habitats, bankfull channel width	• Undercut banks and in-stream structure such as boulders and woody debris (preferred cover of the Redside Dace) • Summer wetted stream widths 0.5 to 20 m, depths 0.1 to 2 m • Substrates include boulders, sand, clay, silt, mud, gravel, and detritus • Relatively clear waters (preference for clear waters, but sometimes occur in moderate turbidity) • Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Deep pools (> 0.6 m depth) with little current (important as refugia for overwintering) • Adequate supply of overwinter prey species (aquatic insect larvae) • High contribution of ground water and stabilized flow conditions
All life stages	Feeding, cover, maintenance of water quality	Riparian vegetation	• 30 m extending from bankfull channel, including, but not limited to, low, overhanging vegetation (grasses, forbs, shrubs) • Adequate supply of terrestrial insect species

Life stage	Function[25]	Feature(s)[26]	Attribute(s)[27]
All life stages	Spawning, cover, nursery, feeding, maintenance of water quality	Meander belt[28]	• Area on either side of a watercourse representing the farthest potential limit of channel migration through time
All life stages	Feeding, cover, maintenance of water quality	Vegetated area beyond meander belt	• 30 m extending from the meander belt (measured horizontally) including, but not limited to, low, overhanging vegetation (grasses, forbs, shrubs) • Adequate supply of terrestrial insect species

[28] The meander belt is not included for watercourses that are classed as municipal drains under Ontario's *Drainage Act.* The meander belt includes and maintains stream channel through time, and maintains channel morphology (which preserves riffle and pool sequences).

Summary of critical habitat relative to population and distribution objectives

These are areas that, based on current best available information, the Minister of Fisheries and Oceans and the Minister responsible for Parks Canada consider necessary to partially achieve the species' population and distribution objectives required for the survival/recovery of the species. Additional critical habitat may be identified in future updates to the recovery strategy and action plan.

8.2 Schedule of studies to identify critical habitat

Further research is required to refine the understanding of the features and attributes and associated functions of the critical habitat that has been identified to support the species' population and distribution objectives, and to protect the critical habitat from destruction. This additional work includes the studies found in table 10. The activities listed in table 10 are not exhaustive and it is likely that the process of investigating these actions will lead to the discovery of further knowledge gaps that need to be addressed.

Table 10. Schedule of studies to refine critical habitat for the Redside Dace.

Description of study	Rationale	Timeline[29]
Identify important habitats required for spawning, incubation, as well as larval and young-of-the-year (YOY) development.	Little information is available regarding the habitat requirements of larval or YOY Redside Dace; will allow refinement of features and attributes of critical habitat and improve ability to identify and protect critical habitat	1 to 3 years
Determine the physiological tolerance of Redside Dace with respect to various water quality parameters (for example, nutrients, contaminants) and check against existing standards.	Will help to refine functions, features, and attributes of critical habitat	3 to 5 years
Identify thresholds of tolerance to habitat modifications (for example, loss of key stream geomorphic features such as deep pools with woody cover).	Will help to refine functions, features, and attributes of critical habitat	5 to 7 years
Conduct studies to further clarify characteristics of overwintering habitat.	Refinement of critical habitat description to ensure seasonal habitat needs are protected	2 to 5 years

[29] Timeline reflects the amount of time required for the study to be completed from the time the recovery strategy and action plan is published as final on the Species at Risk Public Registry. Timelines are subject to change in response to demands on resources and/or personnel and as new priorities arise.

Description of study	Rationale	Timeline[29]
Based on collected information, review population and distribution objectives. Determine amount, configuration and description of critical habitat required to achieve these objectives if adequate information exists.	Refinement of population and distribution objectives, as well as amount configuration and description of critical habitat to meet these objectives	4 to 5 years

8.3 Examples of activities likely to result in the destruction of critical habitat

The following examples of activities likely to result in the destruction[30] of critical habitat (table 11) are based on known human activities that are likely to occur in, and around, critical habitat and would result in the destruction of critical habitat if unmitigated. The list of activities is neither exhaustive nor exclusive and has been guided by the threats described in section 5. The absence of a specific human activity does not preclude or restrict the Department's ability to regulate that activity under SARA. Furthermore, the inclusion of an activity does not result in its automatic prohibition and does not mean that the activity will inevitably result in the destruction of critical habitat. Every proposed activity must be assessed on a case-by-case basis and site-specific mitigation will be applied where it is available and reliable. Where information is available, thresholds and limits have been developed for critical habitat attributes to better inform management and regulatory decision-making. However, in many cases, knowledge of a species and its critical habitat's thresholds of tolerance to disturbance from human activities are lacking and must be acquired.

[30] Destruction occurs when there is temporary or permanent loss of a function of critical habitat at a time when it is required by the species.

Table 11. Examples of activities likely to result in the destruction of critical habitat of the Redside Dace.

Threat	Activity	Effect-pathway	Function affected	Feature affected	Attribute affected
Residential/ commercial development, agriculture, natural system modifications	Work in or around water with improper sediment and erosion control (for example, installation of bridges, pipelines, culverts), overland run-off from ploughed fields, uncontrolled surface run-off from urban and residential development, use of industrial equipment, and cleaning or maintenance of bridges or other structures without proper mitigation Unfettered livestock access to waterbodies Removal of riparian vegetation	Improper sediment and erosion control or mitigation can cause increased turbidity and sediment deposition, changes in preferred substrates, and impairment of feeding and spawning functions. Urban stormwater can cause excessive erosion, stream channel instability, and can result in increased water temperatures. When livestock have unfettered access to waterbodies, damage to shorelines, banks, and watercourse bottoms can cause increased erosion and sedimentation, affecting turbidity and water temperatures. Agricultural lands, particularly those with little riparian vegetation and without tile drainage, allow large inputs of sediments to the watercourse.	Spawning Nursery Feeding Cover	Reaches of streams containing both pool and riffle habitats	• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Relatively clear waters • Substrates include boulders, sand, clay, silt, mud, gravel, and detritus • Riffle areas with gravel substrates (< 60 mm) • Summer wetted stream widths 0.5 to 20 m, depths 0.1 to 2 m • Undercut banks and in-stream structure such as boulders and woody debris (preferred cover of the Redside Dace) • Deep pools with woody debris (> 0.6 m depth) with little current (important as refugia for overwintering) • High contribution of ground water and stabilized flow conditions • Riparian vegetation including, but not limited

Threat	Activity	Effect-pathway	Function affected	Feature affected	Attribute affected
		The removal of riparian vegetation results in loss of habitat for Redside Dace prey species.			to, low, overhanging vegetation (grasses, forbs, shrubs) • Adequate supply of terrestrial insect species
Agriculture, pollution	Over-application of road salts/water softeners and fertilizer, and improper nutrient management (for example, organic debris management, wastewater management, animal waste, septic systems, and municipal sewage)	Improper nutrient management can cause nutrient loading of nearby waterbodies. Elevated nutrient levels (phosphorous and nitrogen) can cause increased turbidity, harmful algal blooms, changing water temperatures, and reduced dissolved oxygen levels. Over-application of road salts can contribute to high chloride levels and the salinization of Redside Dace streams.	Spawning Feeding Cover	Reaches of streams containing both pool and riffle habitats and moderate to high gradient	• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Relatively clear waters • Late spring water temperatures of 16 to 18°C (spawning activities initiate when these temperatures are reached) • Adequate supply of overwinter prey species (aquatic insect larvae)
Residential/ commercial development, agriculture, natural system modifications	Water-level management (for example, through dam operation) or water extraction activities (for example, for irrigation), that causes de-watering of habitat or excessive flow rates; large increases in impervious	Low flows can result in depressed dissolved oxygen levels, elevated temperatures and exposure of spawning habitats. Excessive urban stormwater run-off can result in stream channel instability.	Spawning Feeding Cover	Reaches of streams containing both pool and riffle habitats and moderate to high gradient	• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Summer wetted stream widths 0.5 to 20 m, depths 0.1 to 2 m • Riffle areas with gravel substrates (< 60 mm)

Threat	Activity	Effect-pathway	Function affected	Feature affected	Attribute affected
	surfaces from urban and residential development	Altered flow patterns can affect habitat availability (for example, by de-watering habitats) in creeks and rivers, sediment deposition (for example, changing preferred substrates), and increased water temperatures.			• Deep pools with woody debris (> 0.6 m depth) with little current (important as refugia for overwintering) • Undercut banks and in-stream structures such as boulders and woody debris (preferred cover of the Redside Dace) • High contribution of ground water and stabilized flow conditions
Residential/ commercial development	Over application or misuse of herbicides and pesticides Release of urban stormwater and industrial pollution into habitat (including the impact of stormwater run-off from existing and new developments)	Thermal pollution and introduction of toxic compounds (for example, high chloride levels from stormwater run-off) into habitat used by these species can change water chemistry, affecting habitat.	Spawning Cover	Reaches of streams containing both pool and riffle habitats and moderate to high gradient	• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L
Residential/ commercial development, agriculture, natural system modifications	Dredging Grading Excavation Construction of dams and/or barriers	Alteration of preferred substrates, water depths and flow patterns potentially affecting turbidity, nutrient levels, and water temperatures.	Spawning Cover Feeding	Reaches of streams containing both pool and riffle habitats and	• Summer water temperatures < 24°C, and dissolved oxygen levels > 7 mg/L • Relatively clear waters

Threat	Activity	Effect-pathway	Function affected	Feature affected	Attribute affected
		Dams/barriers, including undersized and/or improperly installed culverts, can result in direct loss of habitat or fragmentation.		moderate to high gradient	• Substrates include boulders, sand, clay, silt, mud, gravel, and detritus • Riffle areas with gravel substrates (< 60 mm) • Summer wetted stream widths 0.5 to 20 m, depths 0.1 to 2 m • Undercut banks and in-stream structure such as boulders and woody debris (preferred cover of the Redside Dace) • Deep pools with woody debris (> 0.6 m depth) with little current (important as refugia for overwintering) • Late spring water temperatures of 16 to 18°C (spawning activities initiate when these temperatures are reached) • High contribution of ground water and stabilized flow conditions • Riparian vegetation including, but not limited to, low, overhanging

Threat	Activity	Effect-pathway	Function affected	Feature affected	Attribute affected
					vegetation (grasses, forbs, shrubs) • Adequate supply of terrestrial insect species

In the future, threshold values for some stressors may be informed through further research. For some of the activities described above, BMPs may be enough to mitigate threats to the species and its habitat; however, in some cases, it is not known if BMPs are adequate to protect critical habitat, and further research is required.

8.4 Proposed measures to protect critical habitat

Section 35 of the *Fisheries Act*, which prohibits the carrying out of any work, undertaking, or activity that results in the harmful alteration, disruption, or destruction of fish habitat, applies to all fish habitat, including the critical habitat for the Redside Dace as described in section 8.1.1 (including the entire bankfull channel width, the meander belt width and the 30 m of riparian vegetation within it, and the vegetated area extending 30 m out from the meander belt width). Except for those areas of critical habitat found in the Rouge National Urban Park, the critical habitat for the Redside Dace will also be legally protected through a SARA critical habitat order made under subsections 58(4) and (5), which will invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat. The areas of critical habitat found in the Rouge National Urban Park will be legally protected by way of a description published in the Canada Gazette, which will trigger the prohibition in subsection 58(1). Under SARA, critical habitat must be legally protected within 180 days of being identified in a final recovery strategy or action plan.

9 Evaluation of socio-economic costs and benefits of the action plan

SARA requires that the action plan component of the recovery document[31] include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation (SARA paragraph 49(1)(e)). This evaluation addresses only the incremental socio-economic costs of implementing this action plan from a national perspective, as well as the social and environmental benefits that would occur if the action plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general, nor does it attempt a cost-benefit analysis. Its intent is to inform the public and to guide decision-making on implementation of the action plan by DFO and its partners.

The protection and recovery of species at risk can result in both benefits and costs. The preamble to SARA recognizes that “wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons”. Self-sustaining and healthy ecosystems with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in, and of, themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; DFO 2008). Furthermore, the

[31] The “action plan component of the recovery document” will simply be referred to as “action plan” from this point forward.

conservation of species at risk is an important component of the Government of Canada's commitment to conserving biological diversity under the *International Convention on Biological Diversity*. The Government of Canada has also made a commitment to protect and recover species at risk through the Accord for the Protection of Species at Risk. An estimate of the costs and benefits associated with this action plan is described below.

This evaluation does not address the socio-economic impacts of protecting critical habitat for Redside Dace. Under SARA, DFO must ensure that critical habitat identified in a recovery strategy or action plan is legally protected within 180 days of the final posting of the recovery document. Where an order will be used for critical habitat protection, the development of the SARA critical habitat order will follow a regulatory process in compliance with the Cabinet Directive on Regulation, including an analysis of any potential incremental impacts of the order that will be included in the regulatory impact analysis statement. As a consequence, no additional analysis of the critical habitat protection has been undertaken for the assessment of costs and benefits of the action plan.

Policy baseline

The policy baseline consists of the protection under SARA for Redside Dace. The species was listed under the SARA as endangered in 2017. The species is afforded additional protections under Ontario's *Endangered Species Act, 2007* where it has been listed as endangered. Further protections may be afforded to Redside Dace and its habitat under other provincial legislation.[32]

Socio-economic costs

The recovery measures in this plan are grouped under 4 broad strategies: management and coordination, inventory and monitoring, research, and stewardship and outreach. Costs would be incurred by the lead agencies to implement the measures listed in the action plan, and by partners who choose to participate in the recovery measures. Some measures are ongoing, whereas others occur once or twice. The present value of the incremental costs of implementing the recovery measures in this plan are anticipated to be less than $400,000 over a 10-year period.[33] Implementation of the actions is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations. Costs would be incurred by the federal government to implement the activities listed in the recovery strategy and action plan. In-kind costs, such as volunteer time, and providing expertise and equipment, would be incurred as a result of implementing activities listed in the recovery strategy and action plan. Costs (including in-kind support) of implementing the recovery measures in this plan could be incurred by the province of Ontario and conservation authorities.

[32] Examples of other provincial legislation that provide habitat protection include, but may not be limited to, considerations under section 2.1.7 of the Provincial Policy Statement (2020) under Ontario's *Planning Act*, which prohibits development and site alteration in habitat of endangered and threatened species, except in accordance with provincial and federal requirements, as well as protection under the *Lakes and Rivers Improvement Act* in Ontario.
[33] The present value of the total incremental costs of the action plan was estimated with a discount rate of 7% over the 10-year period.

Long-term recovery activities will be developed through a cooperative approach, following discussions among other agencies, levels of government, stewardship groups, and stakeholders, allowing for consideration of costs and benefits during the process.

Socio-economic benefits

Some of the benefits of recovery actions required to return/maintain self-sustaining populations of Redside Dace outlined in this recovery strategy and action plan are difficult to quantify but would generally be positive. If implemented, stewardship programs to improve habitat conditions and to reduce threats within critical habitat could help to improve riverine habitat and lead to healthier watersheds through improved water quality.

Some unquantifiable non-market benefits would be enjoyed by the Canadian public as a result of implementing the recovery actions contained in the action plan. Research found that Canadian households had positive and significant willingness to pay values for recovery actions that led to improvements for little known species at risk in southwestern Ontario (Rudd et al. 2016).

In the absence of information on biological outcomes of the measures identified in the action plan, it is not possible to estimate the incremental benefits that can be directly attributed to the implementation of the recovery measures.

Distributional impacts

Governments and conservation authorities will incur the majority of costs of implementing the action plan.

The Canadian public will benefit from the implementation of the action plan through expected non-market benefits associated with recovery and protection of the species and its habitat. Recovery actions that improve riverine habitat will help lead to a healthier ecosystem. This has additional benefits to Canadians, such as improvements to water quality.

10 Measuring progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. A successful recovery program will achieve the overall aim of recovering populations to a state where they are stable or increasing and are demonstrably secure, with low risk from known threats. Progress towards meeting these objectives will be reported on in the report on the progress of recovery strategy implementation, 5 years after the publication of the final document on the Species at Risk Public Registry, and every subsequent 5 years.

Reporting on implementation of the action plan (under section 55 of SARA) will be done by assessing progress towards completing the recovery measures identified after 5 years.

The broader ecological impacts of the implementation of this recovery strategy and action plan have been considered in its development. To report on the ecological impacts of implementation (under section 55 of SARA), monitoring data for other ecological components have been identified.

Performance indicators:

1. The continued presence of Redside Dace throughout its current distribution[34] by 2030
2. Status of Redside Dace in Bronte Creek, Irvine Creek, and Spencer Creek determined by 2026
3. Redside Dace detected in 20% of formerly unoccupied reaches within historical range by 2035 (that is, evidence of expansion)

[34] Current distribution does not include those streams where the species has been determined to be extirpated (refer to Table 2).

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Appendix A: Effects on the environment and other species

In accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan, and Program Proposals (2010), *Species at Risk Act* (SARA) recovery planning documents incorporate strategic environmental assessment (SEA) considerations throughout the document. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy's goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the recovery strategy and action plan itself but are also summarized below in this statement.

This recovery strategy and action plan will clearly benefit the environment by promoting the recovery of Redside Dace. In particular, it will encourage the protection and improvement of riverine habitats. These habitats support species at risk from many other taxa (including birds, reptiles, mussels, and plants) and, thus, the implementation of recovery actions for Redside Dace will contribute to the preservation of biodiversity in general. The potential for these recovery actions to inadvertently lead to adverse effects on other species was considered. The SEA concluded that the implementation of this document will clearly benefit the environment and will not entail any significant adverse environmental effects. For further information, the SEA document serves as a helpful reference, particularly the following sections: section 4.3 (Needs of the Redside Dace), section 5.2 (Description of threats), and section 7.2 (Measures to be taken to implement the recovery strategy and action plan).

Appendix B: Record of cooperation and consultation

Recovery strategies and action plans are to be prepared in cooperation and consultation with other jurisdictions, organizations, affected parties, and others, as outlined in sections 39 and 48 of the *Species at Risk Act*. Fisheries and Oceans Canada (DFO) has utilized a process of a recovery implementation team to seek input during the development of this recovery strategy and action plan. Information on participation is included below.

Table B1. Recovery implementation team members for the Redside Dace as of January 2024.

Name	Affiliation
Jeff Andersen	Ontario Ministry of the Environment, Conservation and Parks
Amy Boyko (Co-chair)	Fisheries and Oceans Canada
Jon Clayton	Credit Valley Conservation Authority
Jamie Davidson	Central Lake Ontario Conservation Authority
Rebecca Dolson	Toronto and Region Conservation Authority
Andrew Drake	Fisheries and Oceans Canada
Andrea Dunn	Ontario Streams
Doug Forder	Ontario Streams
Scott Gibson	Ontario Ministry of Natural Resources and Forestry
Michael Grieve	Central Lake Ontario Conservation Authority
Mark Heaton (Co-chair)	Ontario Streams
Erling Holm	Private citizen
Donald Jackson	University of Toronto
Kari Jean	Ausable Bayfield Conservation Authority
Ian Kelsey	Central Lake Ontario Conservation Authority
David Lawrie	Toronto and Region Conservation Authority
Cindy Lee	Private citizen
Kat Lucas	Ontario Streams
Nick Mandrak	University of Toronto
Aurora McAllister	Ontario Ministry of the Environment, Conservation and Parks
Chelsea McIsaac	Credit Valley Conservation Authority
Mike McKenzie	Trout Unlimited Canada
Madeline Michaud	Ontario Streams
Dan Moore	Central Lake Ontario Conservation Authority
Sam Murchie	Toronto Zoo
Colin Oaks	Hamilton Conservation Authority
Trevor Pitcher	University of Windsor
Gary Pritchard	4 Directions of Conservation Consulting Services
Scott Reid	Ontario Ministry of Natural Resources and Forestry
Andy Turko	University of Guelph
Paul Villard	GEO Morphix Ltd.
Chris Wilson	Ontario Ministry of Natural Resources and Forestry
Rob Wilson	Lake Simcoe Region Conservation Authority

Additional stakeholder, Indigenous, and public input will be sought through the publication of the proposed document on the Species At Risk Public Registry for a 60-day public comment period. Comments received will inform the final document.

Appendix C: Activities already completed or underway

Using occupancy models to assess the effectiveness of underwater cameras to detect rare stream fishes (Castañeda et al. 2020): This University of Toronto research project explored the use of occupancy models to evaluate the probability of detection of Redside Dace using underwater cameras, electrofishing, and seining. The use of multiple underwater cameras was found to be just as effective for detecting the species as compared to traditional electrofishing and seining methods of collection.

Seasonal movement of Redside Dace (*Clinostomus elongatus*) in relation to abiotic and biotic factors (Drake and Poesch 2020): This study investigated the mobility of Redside Dace in 2 tributaries of the Rouge River in response to reach level habitat variables, stream flow, and presence of other species. Using tag-recapture data from a 14-month period, stationarity and mobility results were found to be influenced by temporal and spatial factors. Maximum movement distance of over 600 m was observed during the overwinter period of October to May.

Canadian Standards Association (CSA) released CSA/W202-18 in 2019: This Erosion and Sediment Control Inspection and Monitoring standard was created as a national document to guide consistency in the inspection and performance monitoring of erosion and sediment control measures for construction sites. The standard builds upon the SiltSmart protocol (see below for more information on the SiltSmart Protocol).

Stormwater thermal mitigation: Toronto and Region Conservation Authority (TRCA), working in cooperation with Credit Valley Conservation (CVC), and the City of Brampton, released a report in 2019 investigating the effectiveness of stormwater thermal mitigation in relation to Redside Dace. Results provide recommendations for stormwater pond design for thermal impact mitigation (Van Seters et al. 2019).

In 2014, Ontario Ministry Natural Resources and Forestry (OMNRF), Aurora District, developed a design checklist for thermal mitigation of stormwater management ponds, including bottom draw configuration and deep-water storage criteria.

Guidance for development activities in Redside Dace protected habitat (OMNRF 2016): This document provides guidance to proponents interested in developing land in, and adjacent to, regulated habitats of Redside Dace protected under the provincial *Endangered Species Act 2007*. An overview of best management practices is provided for comprehensive planning for subwatersheds, stream crossings, construction site preparation, stormwater management, installation of infrastructure (for example, gas pipelines, storm sewers, and hydro conduits), and stream realignment and relocation (in situations where they may be unavoidable).

SiltSmart Protocol: This is a sediment and erosion control effectiveness-monitoring protocol that employs the use of real–time continuous monitoring of stream turbidity for large construction sites. The system communicates alarms when site-specific thresholds are exceeded. The protocol was developed by CVC, OMNRF, Ontario Ministry of the Environment and Climate Change, and Fisheries and Oceans Canada (DFO) in 2012 and has been applied to a number of large construction projects in Brampton and Vaughan to protect Redside Dace streams from excessive siltation.

Redside Dace Ontario Government Response Statement (OMNRF 2010): This document lists the provincial government's responses, in the context of policies, to the scientific advice and prescriptions laid out in the Provincial "Recovery Strategy for the Redside Dace (*Clinostomus elongatus*) in Ontario" (Redside Dace Recovery Team 2010), incorporating consulted input from stakeholders, other jurisdictions, Indigenous communities, and members of the public.

Fourteen Mile Creek*:* Municipal stormwater assessments, population monitoring, and habitat rehabilitation work have been ongoing through the work of Conservation Halton, Ontario Streams, and OMNRF. A large reach has been naturalized in conjunction with the Town of Oakville.

Lynde Creek: The Central Lake Ontario Conservation Authority has identified potential Redside Dace habitats in the watershed and confirmed locations of extant populations. Redside Dace has been identified as a target species for management in the recently developed Central Lake Ontario Fisheries Management Plan.

Extensive monitoring: Since 2010, the OMNRF has coordinated substantial targeted monitoring throughout the Ontario range of Redside Dace. Sampling has focused on determining presence/absence of Redside Dace and comparing abundance with historical records. DFO has also undertaken monitoring efforts in Spencer Creek, Irvine Creek, Snow Drain, and Two Tree River in recent years (Barnucz and Drake 2021).

Intensive monitoring: Several streams with Redside Dace populations have been sampled using the Ontario Stream Assessment Protocol through the work of conservation authorities, Ontario Streams, and a University of Toronto research project. In 2019 and 2020, DFO undertook intensive monitoring efforts in Gully Creek and Unknown Stan J (Gáspárdy et al. 2021; Gáspárdy and Drake 2021).

Habitat requirements: A research project at the University of Toronto examined Redside Dace habitat requirements at multiple scales. More recent research at Ohio's Bowling Green State University has investigated preferred habitat structure in streams over 4 seasons. Affinity to woody debris was documented for overwintering (Zimmerman 2009). Currently, the University of Guelph is further investigating overwintering habitat.

Redside Dace feeding: Riparian vegetation, stream habitat, and terrestrial and aquatic invertebrate abundance and diversity were compared at 24 Greater Toronto Area sites that represented an extirpated, declining, or stable Redside Dace population. Greater amounts of grasses were found at stable population sites and more bare ground was present at extirpated sites. Abundance, biomass, and taxa diversity did not vary significantly for terrestrial and aquatic invertebrates. Small sample sizes and high data variability limited the ability to detect significant instream habitat and invertebrate differences among groups (Reid et al. 2019).

Genetic research: Range-wide population genetic structure has been described based on analysis of mitochondrial DNA and microsatellite loci for 28 populations in Ontario and the United States (Serrao et al. 2017a).

Awareness/outreach: The provincial recovery strategy has been promoted at the public Redside Dace display at the Toronto Zoo. The Zoo has also developed a brochure, a curriculum package, and a display focusing on Redside Dace, with support from Canada's Habitat Stewardship Program for Species at Risk.

eDNA monitoring protocols: The use of eDNA analysis as a detection tool has been explored for use in the assessment of Redside Dace distribution and presence/absence in certain stream reaches (Serrao et al. 2017b).

Overall benefit strategy for strategic planning of urban development projects within regulated Redside Dace habitat, West Humber Subwatershed, City of Brampton 2017: Developed by the City of Brampton, with support from OMNRF and TRCA. The document is a comprehensive, subwatershed-based strategy for the West Humber River Subwatershed designed to inform and guide planned capital and development works that have impacts on Redside Dace habitat in the City of Brampton and Town of Caledon.

Reintroduction research: The Freshwater Restoration and Ecology Centre (Great Lakes Institute for Environmental Research, University of Windsor) is conducting an “Overall Benefits” project in Peel region examining issues related to the eventual reintroduction of Redside Dace to subwatersheds of the Credit River. This work includes captive breeding (including induction and environmental cues to stimulate breeding), eDNA sampling for detection, camera detection, etc. This work is ongoing from 2020 to 2025.

Thermal tolerance studies on Redside Dace: There have been 2 studies conducted recently on the thermal tolerance of Redside Dace. The first examined factors that influence individual variation in thermal tolerance and how these may change seasonally. Results suggested that Redside Dace in urban areas will be challenged by predicted future summer temperatures; therefore, habitat restoration to mitigate temperature increases would likely be of benefit to the species (Turko et al. 2020). The second study looked at phenotypic plasticity in critical thermal maximum (CT_{max}) in a northern population of Redside Dace (Two Tree River). Results suggested that CT_{max} of Redside Dace was sensitive to changes in temperature, but with greatest sensitivity during the summer season, suggesting that temperature pulses caused by climate change or urban activities have greatest negative consequences on the species during the summer season (Leclair et al. 2020).

Threat impact research: Studies are underway, using the captive breeding population at the Freshwater Ecology Restoration Centre, to examine the effect of short-term exposure to suspended sediments on schooling ability (group cohesion), and long-term exposure on growth, health, and gill damage (T. Pitcher, University of Windsor, pers. comm. 2020).

Rouge National Urban Park (RNUP) monitoring: Parks Canada (PC) is currently collaborating with Ontario Streams on a targeted monitoring approach for Redside Dace in the RNUP. Surveys began in 2021, and will continue in 2023 and 2025. As part of the current targeted monitoring conducted in partnership with Ontario Streams, the health and suitability of current and historical Redside Dace streams was evaluated in 2021 and will be re-evaluated in 2025.

Restoration work in RNUP (including West Duffins Creek, Petticoat Creek, Rouge River watersheds): Since 2015, working in collaboration with the TRCA, Indigenous partners, farmers, municipalities, schools, and volunteers, PC has implemented 88 ecological restoration and farmland enhancement projects throughout RNUP. These projects have restored more than 80 hectares of wetland, stream and riverbank habitat, 63 hectares of forest habitat, and 5 hectares of meadow habitat. PC has also planted more than 179,700 native trees and shrubs in the RNUP (many by students, community groups, and Indigenous partners), and enhanced habitat connectivity for aquatic wildlife through the removal or improvement of thirteen in-stream barriers throughout the park.

Appendix D: Fisheries partitions

Table D1. Fisheries partitions within the range of the Redside Dace in Ontario.

Watershed	Subwatershed	Partition name	Latitude	Longitude
Spencer Creek	Spencer Creek	Christie Lake Dam	43.278296	-80.007523
Bronte	Bronte	Progreston Dam	43.398092	-79.959996
16 Mile	West Branch	Kelso Dam	43.511340	-79.942366
Credit River	Credit River	Norval Dam	43.648556	-79.859313
Humber River	West Humber River	Clairville Dam	43.737087	-79.630139
Humber River	Purpleville Creek	Lower Cold Creek Farm Weir	43.838850	-79.597135
Rouge River	Rouge River Tributary B	Silver Stream Farms Dam	43.884720	-79.393988
Rouge River	Robinson Creek	RGRC004	43.875753	-79.262736
Rouge River	Bruce Creek	Toogood Pond Dam	43.870437	-79.314059
Duffins Creek	West Branch	Whitevale Dam	43.890854	-79.167751
Duffins Creek	East Branch	Newman's Dam	43.937033	-79.077958
Grand River	Irvine Creek	Salem Dam	43.693605	-80.445222
Gully Creek	Gully Creek	Hwy 21 Barrier	43.613970	-81.705987
Saugeen River	Meux Creek	Neustadt Dam	44.075893	-81.003592
Saugeen River	Saugeen River	Durham Dam	44.178491	-80.817279