

# Recovery Strategy for the Hine's Emerald (*Somatochlora hineana*) in Canada

## Hine's Emerald



2021



Government  
of Canada

Gouvernement  
du Canada

Canada

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](#)<sup>1</sup>.

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<sup>1</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html](http://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html)

# RECOVERY STRATEGY FOR THE HINE'S EMERALD (*Somatochlora hineana*) IN CANADA

2021

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Recovery Strategy for the Hine's Emerald (Somatochlora hineana) in Ontario* (Part 2) and the *Hine's Emerald – Ontario Government Response Statement* (Part 3) under Section 44 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Hine's Emerald in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Hine's Emerald (Somatochlora hineana) in Ontario*, prepared by Environment and Climate Change Canada.

Part 2 - *Recovery Strategy for the Hine's Emerald (Somatochlora hineana) in Ontario*, prepared by Pulfer et al (2013) for the Ontario Ministry of Natural Resources<sup>2</sup>.

Part 3 – *Hine's Emerald – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources, 2013.

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<sup>2</sup> On June 26, 2014, the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.

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Part 3 – *Hine’s Emerald – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources, 2013.

**Part 1 – Federal Addition to the *Recovery Strategy for the Hine's Emerald (Somatochlora hineana) in Ontario*, prepared by Environment and Climate Change Canada**

## Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)<sup>3</sup> agreed to establish complementary legislation and programs that provide for effective 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 for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Hine's Emerald and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of Ontario (Ministry of Natural Resources and Forestry) as per section 39(1) of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Ontario Ministry of Natural Resources (now the Ontario Ministry of Natural Resources and Forestry) led the development of the attached recovery strategy for the Hine's Emerald (Part 2) in cooperation with Environment and Climate Change Canada. The Province of Ontario also led the development of the attached Government Response Statement (Part 3), which is the Ontario Government's policy response to its provincial recovery strategy and summarizes the prioritized actions that the Ontario government intends to take and support.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Hine's Emerald and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

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<sup>3</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2](http://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2)

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area<sup>4</sup> be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

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<sup>4</sup> These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

## **Acknowledgements**

The original draft of the federal addition was prepared by Talena Kraus (Artemis Eco-Works). Subsequent drafts were developed by Ken Tuininga, Lee Voisin, Allison Foran, Elisabeth Shapiro, Angela Darwin, Shady Abbas (ECCC, Canadian Wildlife Service – Ontario ) and Megan Eplett, Kristina Fitzgerald (formerly ECCC, CWS-Ontario). Lesley Dunn, Elizabeth Rezek, Krista Holmes (ECCC, CWS-Ontario), Sarah Parna, Marie Vavro, Mark Hulsman, Lucy Ellis, Glenn Desy, Colin Jones (Ontario Ministry of Natural Resources and Forestry) reviewed and provided comments and advice during the development of this document. Helpful information was also provided by Dave Featherstone (Nottawasaga Valley Conservation Authority).

Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy.

## Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Recovery Strategy for the Hine's Emerald* (*Somatochlora hineana*) in Ontario (Part 2 of this document, referred to henceforth as “the provincial recovery strategy”) and/or to provide updated or additional information.

Environment and Climate Change Canada is adopting the Ontario recovery strategy (Part 2) with the exception of section 2.0, Recovery. In place of section 2.0, ECCC has established a population and distribution objective and performance indicators, and is adopting the Government of Ontario's government-led and government-supported actions of the *Hine's Emerald – Ontario Government Response Statement* (Part 3) as the broad strategies and general approaches to meet the population and distribution objective.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery strategy referring to protection of the species' habitat may not directly correspond to federal requirements. Recovery measures dealing with the protection of habitat are adopted; however, whether these measures will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

## Recovery Feasibility Summary

The Government of Canada published the [Proposed] “Species at Risk Policies -Policy on Survival and Recovery” (2016)<sup>5</sup> to guide consistent interpretation of major concepts applicable under SARA . Recovery feasibility for the Hine's Emerald was assessed following this guidance. If new information becomes available or if required due to amendments to the Policy on Survival and Recovery, feasibility may be re-assessed in an amendment to this recovery strategy.

Based on the best available information, the Hine's Emerald was probably never particularly widespread or abundant within Canada and is considered to be historically precarious<sup>6</sup> in Canada (see Appendix A for details). It was discovered in Canada in 2007 and, despite extensive targeted and general surveying, is only known from one isolated location (COSEWIC 2011). For a species with this historical context, the Government of Canada uses the criteria in Table 1 below to determine whether recovery for this species is technically and biologically feasible.

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<sup>5</sup> [http://registrelep-sararegistry.gc.ca/document/default\\_e.cfm?documentID=2985](http://registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=2985)

<sup>6</sup> A species that, prior to significant effects from human activity, was below the survival threshold or was dependent on demographic connectivity with outside populations for the long-term presence in Canada according to the best available information on the species population in Canada. Such a species may be recovered by achieving a condition that approximates its historical state (GOC 2016).

For a species that is determined to be historically precarious, recovery will be considered feasible if the extent of irreversible change<sup>7</sup> is such that under the best achievable scenario<sup>8</sup> it is technically and biologically feasible to improve the condition of the species to a point that it is approaching the historical condition<sup>9</sup>. The main instance of irreversible change that must be considered for the Hine's Emerald is the permanent loss, degradation, and fragmentation of suitable habitat.

There are unknowns regarding the feasibility of recovery for the Hine's Emerald. In keeping with the precautionary principle, a recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This recovery strategy attempts to address the unknowns surrounding the feasibility of recovery. A more thorough discussion of the recovery feasibility assessment for the Hine's Emerald can be found in Appendix A.

### **Assessing Recovery Feasibility**

To determine whether recovery is technically and biologically feasible for a historically precarious species, such as the Hine's Emerald, any information that is known or estimated about the historical condition of the species should be used to understand the appropriate context of each fundamental characteristic of the species (Table 1) (GOC 2016; Appendix A).

**Table 1. Determination of Recovery Feasibility for Historically Precarious Species**

<b>Fundamental Species Characteristic</b>	<b>Recovery Threshold</b>	<b>Technically and Biologically Feasible to Achieve Recovery Threshold Quickly Enough to Help the Species? (Y/N/Unknown)</b>
<b>Population Trend</b>	Approximating historical condition	Unknown
<b>Resilience (Population size)</b>	Approximating historical condition	Unknown
<b>Redundancy (Population # / Distribution)</b>	Approximating historical condition	Unknown
<b>Population Connectivity</b>	Approximating historical condition	Unknown

<sup>7</sup> A change that results in the establishment of a new set of ecological or biological conditions that constrain the ability of the species to return to its historic condition and which cannot reasonably be changed in a way that improves those conditions for the species within a biologically relevant time frame (e.g., loss of genetic diversity, loss of food/host species, effects of permanent infrastructure) (GOC 2016).

<sup>8</sup> The biologically and technically achievable scenario with the lowest possible risk of extinction to the species that can be achieved, taking into account irreversible change (GOC 2016).

<sup>9</sup> An estimate of the historic level of redundancy, resilience, representation, population and distribution, trend, threats, ecological role and any other factors that together determine the risk of extinction or extirpation of the species in Canada prior to significant effects of human activity, based on best available information (GOC 2016).

<b>Fundamental Species Characteristic</b>	<b>Recovery Threshold</b>	<b>Technically and Biologically Feasible to Achieve Recovery Threshold Quickly Enough to Help the Species? (Y/N/Unknown)</b>
<b>Mitigation of Human-caused Threats</b>	Significant threats avoided or mitigated to the extent that they no longer threaten the species	Yes
<b>Species Condition</b> <sup>10</sup>	Improved over when first assessed as at risk	Unknown
<b>Representation (Species presence in appropriate ecological communities)</b>	Approximating historical condition at a coarse scale	Unknown
<b>Independent of connectivity with populations outside of Canada</b>	Yes: connectivity may be important but cannot be necessary	Yes
<b>Independent of Species Interventions</b>	Yes	Yes

## Narrative to Support Recovery Feasibility

The distribution of the Hine's Emerald in Canada is highly localized and the species is limited to marshes, fens and nearby forested areas. The species is rare throughout its North American range and in Canada is only found at one site in the Minesing Wetlands (COSEWIC 2011). It is not known if additional populations of the Hine's Emerald existed in Canada historically. The species is not considered to be connected to any other populations and the nearest source population is 280 km away in Michigan. It is likely that the Minesing population will remain highly isolated unless future survey efforts discover nearby populations. Natural dispersal distance is limited for this species; the maximum recorded dispersal distance is 5.4 km (Mierzwa 1995; Cashatt and Vogt 1996), making natural dispersal and colonization of this area unlikely.

Within the wetland, the species occupies southern Ontario's rare fen habitat (Bowles et al. 2007) and survival is in part dependent upon the maintenance of the fen's water quality and overall hydrological patterns. Corridors between habitat patches are important for movement and dispersal of the species (Foster and Soluk 2004). Crayfish burrows are also required which may further reduce the amount of suitable habitat available to the Hine's Emerald (COSEWIC 2011). The Minesing Wetlands are surrounded by agriculture and rural residential development which increases nutrient loading and pollution (Pulfer et al. 2013), and may also affect connectivity within the current Hine's Emerald population. These pressures, along with the isolated nature of

<sup>10</sup> The condition of the species refers to the combination of the level of redundancy, resilience, representation, population and distribution, trend, threats, ecological role and any other factors that together determine the risk of extinction or extirpation of the species in Canada (GOC 2016).

the Minesing population make the species particularly sensitive to chance weather events, habitat fragmentation and degradation. As a result, maintaining the quality of existing habitat is essential to the Hine's Emerald's survival.

The species' historical condition in Canada is not well documented, as it was first observed in 2007; however it has been recorded regularly since this date (COSEWIC 2011). Negative search efforts suggest that if the species occurs at other locations in Canada, it exists at only a few (COSEWIC 2011). Without population estimates, it is not possible to determine whether the Minesing Wetlands' Hine's Emerald population is stable or declining.

Given the unknowns concerning the historical condition of the Hine's Emerald as well as the uncertainty of abundance, the feasibility of recovery for the Hine's Emerald in Canada is considered unknown. It is likely that the species was never widespread in Canada, and will likely continue to be considered rare in Canada despite recovery actions to mitigate threats and fill in knowledge gaps given the species' biology and specific habitat requirements.

## 1. COSEWIC\* Species Assessment Information

**Date of Assessment:** May 2011

**Common Name (population):** Hine's Emerald

**Scientific Name:** *Somatochlora hineana*

**COSEWIC Status:** Endangered

**Reason for Designation:** This dragonfly, which is rare throughout its range, is known from only one Canadian location where habitat decline is considered likely due to urban development and invasive species.

**Canadian Occurrence:** Ontario

**COSEWIC Status History:** Designated Endangered in May 2011

\* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

## 2. Species Status Information

The Hine's Emerald was listed as Endangered<sup>11</sup> on Schedule 1 of the federal *Species at Risk Act* (SARA) in 2017. In Ontario, the species is listed as Endangered<sup>12</sup> under the *Endangered Species Act, 2007* (ESA) (S.O. 2007, c. 6) and receives species and habitat protection under the ESA.

<sup>11</sup> A wildlife species facing imminent extirpation or extinction.

<sup>12</sup> A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

The rounded global rank for the Hine's Emerald is Imperiled (G2). It is considered Critically Imperiled (N1) in Canada and Critically Imperiled (S1) in Ontario (NatureServe 2017; Appendix B). The International Union for Conservation of Nature (IUCN) lists the species as being Near Threatened<sup>13</sup> globally (Abbott and Cashatt 2007).

It is estimated that less than 5% of the species' range is in Canada (COSEWIC 2011).

### 3. Threats

As described in the provincial recovery strategy (Part 2, Section 1.6), alteration of hydrology, invasive species, contamination of groundwater, road mortality, human-caused disturbance to habitat and direct human-caused mortality are ongoing or potential threats to the Hine's Emerald (Pulfer et al. 2013).

In addition to those threats identified in Part 2, another potential threat that may affect the Hine's Emerald is invasive species hybridization. Non-native European Common Reed (*Phragmites australis australis*) poses a double threat to the Hine's Emerald, firstly through its ability to rapidly colonize, outcompete and exclude native species, and secondly through its ability to replace native species via hybridization; both mechanisms may result in changes to plant community structure and composition thereby reducing the availability of suitable habitat for the Hine's Emerald. In recent years, European Common Reed has been documented along the edges of the Minesing Wetlands, although encroachment into Hine's Emerald habitat has not yet occurred (Rootham and Featherstone 2014; Featherstone pers. comm. 2017). While European Common Reed can reproduce through rhizomes<sup>14</sup> it has also been recently documented hybridizing with native Common Reed (*Phragmites australis americanus*), however, the severity of this threat is not yet known (Saltonstall et al. 2014). It is suspected that the increased presence of European Common Reed will increase the likelihood of hybridization (Wu et al. 2015). Native Common Reed is currently scattered throughout the fen habitat of the Minesing Wetlands where Hine's Emerald is found. If European Common Reed were to spread into these areas and hybridize with native Common Reed, this could increase European Common Reed identification and control issues and more quickly render the area unsuitable for the Hine's Emerald. Due to uncertainties associated with optimal hybridization conditions and vigor, immediately removing hybrid plants is recommended (Saltonstall and Blossey 2014).

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<sup>13</sup> A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

<sup>14</sup> A continuously growing horizontal underground stem.

## 4. Population and Distribution Objectives

Under SARA, a population and distribution objective must be established for listed endangered, threatened and extirpated species when recovery is deemed feasible. The population and distribution objective established by ECCC for the Hine's Emerald is:

- To maintain the persistence of the species and its habitat at extant sites in Canada.

There is currently one known location for the Hine's Emerald in Ontario, but this species can be difficult to find, particularly in areas with small populations (COSEWIC 2011). This location is believed to support one population, and both adults and larvae have been found (COSEWIC 2011). At all life stages, the Hine's Emerald relies on the habitat in and around the wetland in which it occurs, and on the hydrogeological processes maintaining the wetland. The population size and viability are not currently known, and development of monitoring protocols and monitoring of the species, and best management practices for protection of habitat, are priorities. Maintaining habitat connectivity between extant sites is also important. This population and distribution objective would include new sites if discovered.

This federal population and distribution objective is consistent with the province of Ontario's Government Response Statement developed under the provincial *Endangered Species Act*, which outlines the provincial government's goal for the recovery of the species and summarizes the prioritized actions the government intends to take and support (see Part 3 for more information). The government of Ontario's goal for the recovery of the Hine's Emerald is to maintain the persistence of the species and its habitat where it currently exists in Ontario.

## 5. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported action tables from the *Hine's Emerald – Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objectives. ECCC is not adopting the approaches identified in section 2.3 of the *Recovery Strategy for the Hine's Emerald* (*Somatochlora hineana*) in Ontario (Part 2).

## 6. Critical Habitat

### 6.1 Identification of the Species' Critical Habitat

Section 41(1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Under section 2(1) of SARA, critical habitat is "the

habitat that is 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”.

Identification of critical habitat is not a component of provincial recovery strategies under the Province of Ontario's ESA. Following the completion of the provincial recovery strategy for this species, a provincial habitat regulation was developed for the Hine's Emerald in Ontario, effective January 1, 2015 (section 27.3 of Ontario Regulation 242/08<sup>15</sup>). A habitat regulation is a legal instrument that prescribes an area that will be protected<sup>16</sup> as the habitat of the species by the Province of Ontario. The habitat regulation identifies the geographic area within which the habitat regulation may apply and explains how the boundaries of regulated habitat are determined (based on biophysical and other attributes). The regulation is dynamic and automatically in effect wherever and whenever the description(s) of the regulation are met. Refer to the *Habitat Protection Summary for Hine's Emerald* (OMNR 2014) for further details on the provincial habitat regulation and its application. The identification of critical habitat for the Hine's Emerald is based on components of the habitat regulation to promote consistency between the federal SARA and the provincial ESA in protecting critical habitat on federal and non-federal lands.

Critical habitat for the Hine's Emerald in Canada is identified as the extent of biophysical attributes (Section 6.1.2) wherever they occur within areas described in Section 6.1.1. The area containing critical habitat for Hine's Emerald is presented in Figure 1. The UTM grid squares (Figure 1, Table 2) are part of a standardized grid system that indicates the general geographic areas containing critical habitat, which can be used for land use planning and/or environmental assessment purposes. Critical habitat is identified for the only known population of Hine's Emerald in Canada, and is considered sufficient to achieve the population and distribution objectives; therefore, no schedule of studies has been developed. If new or additional information becomes available, refinements to, or additional critical habitat may be identified in an amendment to this recovery strategy. For more information on critical habitat identification, contact Environment and Climate Change Canada – Canadian Wildlife Service at [ec.planificationduretablissement-recoveryplanning.ec@canada.ca](mailto:ec.planificationduretablissement-recoveryplanning.ec@canada.ca)

### 6.1.1. Area Containing Critical Habitat

In Canada, the presence and persistence of the Hine's Emerald depends on an area greater than that occupied by individuals of the species. It requires ecological or

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<sup>15</sup> [www.ontario.ca/laws/regulation/080242#BK67](http://www.ontario.ca/laws/regulation/080242#BK67)

<sup>16</sup> Under the federal *Species at Risk Act* (SARA), there are specific requirements and processes set out regarding the protection of critical habitat. Protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

landscape features that promote and maintain suitable habitat<sup>17</sup> for the dragonfly and allow for natural processes related to population dynamics and reproduction to occur.

The area containing critical habitat has been delineated<sup>18</sup> as follows:

- 1) Any part of a wetland, pond or other body of water where there is a known observation of a Hine's Emerald with evidence of egg laying or larval development; AND
- 2) Any part of a wetland, watercourse, pond or other body of water that is within 1600 metres of an area described in (1); AND
- 3) Any area that does not have an impervious surface and that is within 500 metres of an area described in (2).

The 1600 metre distance represents the average distance the Hine's Emerald will travel to carry out life processes, mainly foraging, mating, refuge and rest (OMNR 2014). The 500 metre distance is included for the purposes of perching, movement and roosting in adjacent pervious terrestrial areas and because it contributes to the maintenance of groundwater flow into the wetlands or aquatic areas. (Pulfer et al. 2013).

### 6.1.2 Biophysical Attributes of Critical Habitat

The biophysical attributes of critical habitat include the characteristics described below.

- Wetlands, watercourses, seepage areas, ponds or other bodies of water, including vernal<sup>19</sup> or other temporary pools typically characterized by the following:
  - Cool, shallow, slowly-moving waters of spring-fed marshes, alkaline fens and mineral-rich fens<sup>20</sup> with shallow creeks, springs, small pools, marl<sup>21</sup> deposits and calcareous marshy streams (Pintor and Soluk 2006);
  - Calcareous wetlands including marshes, meadow marshes and fens dominated by graminoid vegetation (particularly sedges) and fed primarily by groundwater from intermittent seeps (COSEWIC 2011);
  - Shallow channels or sheetflow<sup>22</sup> in areas of herbaceous vegetation that may include cattails (*Typha* spp.) and sweetflag (*Acorus* spp.) in marshes, meadow marshes and fens (COSEWIC 2011).

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<sup>17</sup> Suitable habitat is composed of the biophysical attributes (e.g. soil and moisture conditions, light penetration, species composition and species interactions) that provide individuals of the species the necessary conditions to carry out essential life processes.

<sup>18</sup> Based on data available to ECCC as of January 2020.

<sup>19</sup> Occurring in the spring.

<sup>20</sup> Alkaline and mineral rich fens are fens that are typically fed by streams or springs that have flowed over or through rocks or other minerals, often acquiring dissolved minerals which raise the nutrient levels and reduce the acidity of the soils.

<sup>21</sup> A calcium carbonate or lime-rich mud or mudstone which contains variable amounts of clays and silt.

<sup>22</sup> An overland flow or downslope movement of water taking the form of a thin, continuous film over relatively smooth soil or rock surfaces and not concentrated into significant channels.

- Adjacent pervious areas including but not limited to:
  - Vegetated areas with predominantly herbaceous growth (COSEWIC 2011);
  - Forest and forest edges, shrub thickets, old fields, grasslands and hedgerows (OMNR 2014).
  
- The presence of crayfish burrows (e.g., created by Digger Crayfish (*Fallicambarus fodiens*)) in one or more of the above habitat types (Evans et al. 2015).

The presence of crayfish burrows is necessary for the survival of larvae, providing refuge in the summer when conditions are dry, and protection from harsh conditions in the winter (COSEWIC 2011). For this reason, crayfish burrows must be present in one or more of the habitat types listed above and found within the area containing critical habitat shown in Figure 1. Although essential for the survival of the species, crayfish burrows can be difficult to locate.

Within the geographic area described in section 6.1.1, critical habitat is present where the biophysical attributes described above are found. Areas that do not allow water to filter into the soil, such as paved roadways, other paved areas, sidewalks and buildings do not possess the biophysical attributes of suitable habitat or assist in the maintenance of conditions required by Hine's Emerald, and are therefore not identified as critical habitat.

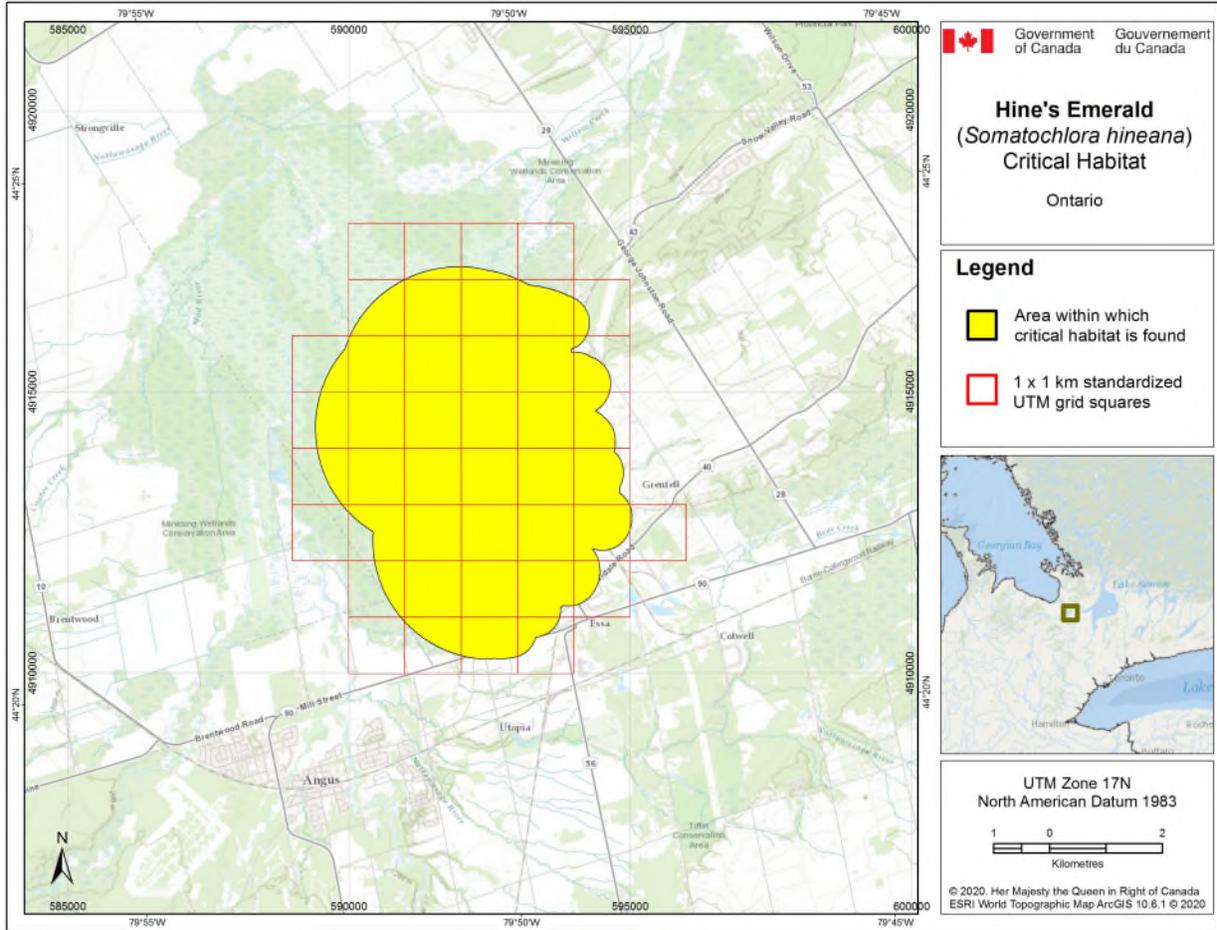


Figure 1. The area within which critical habitat for the Hine's Emerald is found in Ontario, Canada is represented by the yellow unit. Standardized UTM grid squares are displayed in red.

**Table 2. Grid squares that contain critical habitat for the Hine's Emerald in Canada.** Critical habitat for the Hine's Emerald occurs within these 1 x 1 km standardized UTM grid squares where the description of critical habitat is met.

1 x 1 km standardized UTM grid square ID <sup>a</sup>	Province/Territory	UTM Grid Square		Land tenure <sup>c</sup>
		Easting	Northing	
17TNK8192	Ontario	589500	4912500	Non-federal Land
17TNK8193	Ontario	589500	4913500	Non-federal Land
17TNK8194	Ontario	589500	4914500	Non-federal Land
17TNK8195	Ontario	589500	4915500	Non-federal Land
17TNK9100	Ontario	590000	4911000	Non-federal Land
17TNK9101	Ontario	590000	4912000	Non-federal Land
17TNK9102	Ontario	590500	4912500	Non-federal Land
17TNK9103	Ontario	590500	4913500	Non-federal Land
17TNK9104	Ontario	590500	4914500	Non-federal Land
17TNK9105	Ontario	590500	4915500	Non-federal Land
17TNK9106	Ontario	590500	4916500	Non-federal Land
17TNK9107	Ontario	590500	4917500	Non-federal Land
17TNK9110	Ontario	591000	4910000	Non-federal Land
17TNK9111	Ontario	591000	4911000	Non-federal Land
17TNK9112	Ontario	591500	4912500	Non-federal Land
17TNK9113	Ontario	591500	4913500	Non-federal Land
17TNK9114	Ontario	591500	4914500	Non-federal Land
17TNK9115	Ontario	591500	4915500	Non-federal Land
17TNK9116	Ontario	591500	4916500	Non-federal Land
17TNK9117	Ontario	591500	4917500	Non-federal Land
17TNK9120	Ontario	592000	4910000	Non-federal Land
17TNK9121	Ontario	592000	4911000	Non-federal Land
17TNK9122	Ontario	592500	4912500	Non-federal Land
17TNK9123	Ontario	592500	4913500	Non-federal Land
17TNK9124	Ontario	592500	4914500	Non-federal Land
17TNK9125	Ontario	592500	4915500	Non-federal Land
17TNK9126	Ontario	592500	4916500	Non-federal Land

1 x 1 km standardized UTM grid square ID <sup>a</sup>	Province/Territory	UTM Grid Square		Land tenure <sup>c</sup>
		Easting	Northing	
17TNK9127	Ontario	592500	4917500	Non-federal Land
17TNK9130	Ontario	593000	4910000	Non-federal Land
17TNK9131	Ontario	593000	4911000	Non-federal Land
17TNK9132	Ontario	593500	4912500	Non-federal Land
17TNK9133	Ontario	593500	4913500	Non-federal Land
17TNK9134	Ontario	593500	4914500	Non-federal Land
17TNK9135	Ontario	593500	4915500	Non-federal Land
17TNK9136	Ontario	593500	4916500	Non-federal Land
17TNK9137	Ontario	593500	4917500	Non-federal Land
17TNK9141	Ontario	594000	4911000	Non-federal Land
17TNK9142	Ontario	594500	4912500	Non-federal Land
17TNK9143	Ontario	594500	4913500	Non-federal Land
17TNK9144	Ontario	594500	4914500	Non-federal Land
17TNK9145	Ontario	594500	4915500	Non-federal Land
17TNK9146	Ontario	594500	4916500	Non-federal Land
17TNK9152	Ontario	595000	4912000	Non-federal Land

<sup>a</sup> Based on the standard UTM Military Grid Reference System (see <http://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9789>), where the first 2 digits represent the UTM Zone, followed by a letter representing the UTM Band, the following 2 letters indicate the 100 x 100 km standardized UTM grid, followed by 2 digits to represent the 10 x 10 km standardized UTM, and the last 2 digits indicate the 1 x 1 km standardized UTM grid containing all or a portion of the area within which critical habitat is found. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See <http://www.bsc-eoc.org> for more information on breeding bird atlases).

<sup>b</sup> The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 1 x 1 km standardized UTM grid square. The coordinates are provided as a general location only.

<sup>c</sup> Land tenure is provided as an approximation of the types of land ownership that exist at the area within which critical habitat is found and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

## **6.2 Activities Likely to Result in the Destruction of Critical Habitat**

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat was degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time. It should be noted that not all activities that occur in or near critical habitat are likely to cause its destruction. Activities described in Table 3 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

**Table 3. Activities Likely to Result in the Destruction of Critical Habitat**

<b>Description of activity</b>	<b>Description of effect (biophysical attribute or other) in relation to function loss</b>	<b>Details of effect</b>
<p>Alteration of hydrology (e.g., residential or agricultural development in groundwater recharge areas).</p>	<p>The alteration of hydrology associated with residential and agricultural development would lead to an increase in impermeable surfaces, which would likely reduce the amount of groundwater reaching the species' wetland habitat.</p> <p>Rapid development in recharge areas may also alter important groundwater recharge. This alteration of hydrology would also lead to an increase in the amount of water taken from the recharge area which would in turn decrease the amount of water reaching the wetland habitat. This decrease would lead to both a reduction in water flow and a loss of wet areas upon which Hine's Emerald larvae, and the crayfish digging the burrows that support them, rely. It could also lead to vegetative succession in the fen areas, which would likely reduce the habitat available for larvae and breeding adults.</p>	<p>If this activity were to occur at any time of the year, within or outside of critical habitat (affecting the hydrology of the wetland), it would be highly likely to result in its destruction because the majority of the wetland supporting the Hine's Emerald is dependent on the movement of groundwater from recharge areas to the wetland, and a reduction in the amount of water reaching the fen would result in a loss of habitat for breeding adults, aquatic larvae, and the crayfish on whose burrows the larvae rely.</p>
<p>Contamination of groundwater and surface water (e.g., large-scale agricultural activities, use of road salt or urban contaminants including discharge from poorly maintained septic beds in groundwater recharge areas).</p>	<p>Contamination of groundwater and surface waters could lead to the presence of nutrients and other contaminants in the water in the fen, which would contaminate the water in which the larvae live and may detrimentally affect larval growth and/or survival, reducing the amount of suitable aquatic habitat provided by the fen.</p>	<p>If this activity were to occur at any time of the year within or adjacent to critical habitat, it would be likely to result in its destruction. Increased levels of nutrients, sodium and chloride have been found at the periphery of the Minesing Wetlands but not (yet) in the fen habitat. If there is an increase in the amount of contaminants in the water in the recharge areas, it is probable that levels at the periphery would increase and that contaminants would reach the fen.</p>

<p>Introduction of invasive species and activities that promote the expansion of invasive species (e.g., activities that introduce non-native invasive plant seeds or trample fen habitats through high levels of recreational activities).</p>	<p>If European Common Reed, Glossy False Buckthorn (<i>Frangula alnus</i>), Garlic Mustard (<i>Alliaria petiolata</i>) and Purple Loosestrife (<i>Lythrum salicaria</i>) continue to expand in Hine's Emerald habitat (including expansion via hybridization), they are likely to displace native plants and alter habitat conditions such that conditions are no longer suitable for Hine's Emerald.</p> <p>Hiking in areas with invasive species followed by entry into natural habitat could spread seeds of these species. If Glossy False Buckthorn or European Common Reed in particular, continues to encroach into the fen area of the Minesing Wetlands, the fen habitat could be significantly impacted, possibly restricting or eliminating burrowing crayfish activity in Hine's Emerald breeding sites.</p> <p>Fens are also sensitive to trampling, which could lead to changes in the ecology of the fen along areas of flow in which larvae live, destruction of the crayfish burrows in which larvae survive drought and winter, and possible destruction of larvae.</p>	<p>If this activity were to occur at any time of the year, particularly spring or summer, within or adjacent to critical habitat, it is likely to result in its destruction. The fen habitat is difficult to access and access is restricted; such high levels of human disturbance are currently unlikely.</p>
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## 7. Measuring Progress

The performance indicator presented below provides a way to define and measure progress toward achieving the population and distribution objectives. Every five years, success of recovery strategy implementation will be measured against the following performance indicator:

- The persistence of the Hine's Emerald and its habitat have been maintained at extant sites in Canada.

## 8. Statement on Action Plans

One or more action plans will be completed and posted on the Species at Risk Public Registry for the Hine's Emerald by December 31, 2026.

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## **Appendix A: Recovery Feasibility Assessment**

### **Extent of Irreversible Change**

The Hine's Emerald's only known location in Canada is in the Minesing Wetlands, near Barrie, Ontario. Throughout its life process, the Hine's Emerald uses marshes, fens<sup>23</sup> and surrounding forests and fields and openings along trails and roadsides (COSEWIC 2011). Fen habitat is rare in southern Ontario (Bowles et al. 2007). Much of the landscape of southern Ontario between the Minesing population and those in the United States has been heavily modified by drainage and clearing for agriculture, residential and commercial development. Along the outer edges of the Minesing Wetlands significant changes to drainage were made to accommodate agriculture in adjacent lands. Some of the surrounding forest habitats have also been degraded and lost to landscape alteration for urban and agricultural development, and expansion of invasive species. There have been significant changes to the landscape around the Minesing Wetlands, impacting much of the Minesing Wetlands (Rootham and Featherstone 2014). Presently, the size of the Minesing Wetlands' population is not known, and the amount of habitat needed to support the species has not been determined. However, more effort can be made to improve the quality of the remaining habitat and promote the surveying of suitable habitat to increase accurate reporting of this species in Canada.

### **Historical Context**

The first step in determining the recovery feasibility of the Hine's Emerald is to establish the historical context (whether the species' existence in Canada was historically precarious or not precarious). To make this determination, Environment and Climate Change Canada uses the four criteria outlined below. A species is considered to have been historically precarious if any of the following are known or likely to have been true in Canada, prior to significant effects from human activity:

1. The species was undergoing a long-term natural decline;
  - Unknown. The species was found for the first time in Canada in 2007 and despite repeated survey effort, it is only known from a single location. It is considered rare both across its global range and in Canada. It is not known if it has undergone long-term natural decline, though future decline is possible due to invasive species and urban development (COSEWIC 2011).
2. The species consisted of fewer than 1,000 mature individuals;
  - Unknown. The exact number of mature individuals is unknown and recent observations (e.g., within the past 10 years) have been of single or a small number of individuals. It is unknown if the species historically existed in much higher numbers.

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<sup>23</sup> A wetland typically having alkaline, but sometimes neutral, or only slightly acid peaty soil.

3. The species existed at five or fewer locations<sup>24</sup> or less than 20 km<sup>2</sup> index of area of occupancy<sup>25</sup> (IAO);
  - Unknown. The Hine's Emerald is known from only one location in Canada despite survey efforts at other potentially suitable locations. Although there has been extensive wetland loss in southern Ontario, additional surveys at other locations in potentially suitable remaining habitats have been unsuccessful to date. The species has an index of area of occupancy (IAO)<sup>26</sup> of 28 km<sup>2</sup> (COSEWIC 2011).
4. The species was dependent on connectivity with populations outside Canada for its long term presence in Canada.
  - No. There is no evidence to suggest that historic or current Hine's Emerald populations in Canada were connected to populations in the United States due to the species' limited dispersal, specific habitat needs, and vast geographic separation between populations. The closest occurrence in the US is 280 km away in Michigan (COSEWIC 2011).

### ***Population Trend***

For the purposes of determining recovery feasibility, the species trend refers to whether a species population can become stable or increase over a biologically relevant timeline. The Hine's Emerald was first recorded in Canada in 2007, consequently there is no information on species decline prior to that time.

Most surveys have found fewer than 10 individuals at the species' only known location. Negative search efforts suggest that if the species occurs at other locations in Canada, it may exist at only a few (COSEWIC 2011). Without population estimates it is not possible to determine whether the Minesing Wetlands' Hine's Emerald population is stable or declining.

### ***Resilience (Population size)***

Resilience is the species' ability to recover after a disturbance and is critical to the survival of a species that is historically precarious. Although a larger population size does not protect against all threats, it is a strong predictor of resilience against increasing rates of decline due to inbreeding or chance events (Elphick et al. 2001; McGowan et al. 2014).

The minimum viable population<sup>27</sup> size for the Hine's Emerald has not been determined; however, establishing this will provide necessary information on the number of individuals

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<sup>24</sup> Location defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present (IUCN Standards and Petitions Subcommittee 2014).

<sup>25</sup> An estimate of the area of habitat occupied by a wildlife species that is not dependent on scale (COSEWIC 2015).

<sup>26</sup> A biologically defensible estimate of the occupied habitat within a wildlife species' range. Measured by an estimate of the number of grid squares occupied by extant populations ([http://www.cosewic.gc.ca/eng/sct2/sct2\\_6\\_e.cfm](http://www.cosewic.gc.ca/eng/sct2/sct2_6_e.cfm)).

<sup>27</sup> An estimate of the number of individuals required for a high probability of survival of a population over a given period of time.

needed to maintain a self-sustaining population that is resilient against chance weather events (e.g., early frost, severe drought), and will aid in determining if recovery of the species is technically and biologically feasible.

***Redundancy (Population size and distribution)***

Redundancy refers to the number of local populations and their distribution. If one local population is damaged or destroyed, others can act as a source to restore this missing population. Persistence of the Minesing Wetlands Hine's Emerald population is governed by the survival of the species at its only known location. This makes the species particularly sensitive to chance weather events and extirpation as the nearest source population in Michigan is 280 km away. Fen habitats account for less than one percent of the total wetland area south of the Canadian Shield in Ontario (Riley 1989) and community types suitable for the Hine's Emerald make up only a small part of this habitat (Pulfer et al. 2013). The need for crayfish burrows to be present may further reduce the amount of suitable habitat available to the Hines's Emerald (COSEWIC 2011). Due to the rarity of the habitat type and the negative search results from extensive surveying of potentially suitable habitat, it is unlikely that many other populations exist in Ontario/Canada (COSEWIC 2011), however, it is possible that populations exist within at least a few of the previously surveyed sites in Ontario due to difficulties associated with detecting the species (Pulfer et al. 2013).

The historical condition of the Hine's Emerald in Canada is not known, though the species is rare throughout its North American range (COSEWIC 2011) and was thought to be distributed widely and patchily in the northeastern United States and southeastern Canada (USFWS 1999 in Foster and Soluk 2004). Significant drainage alterations have occurred in southern Ontario, as well as along the perimeter of the Minesing Wetlands following European Settlement. These activities have affected hydrology and vegetation communities, however, much of the Minesing Wetlands remains in a relatively pristine state (Bowles et al. 2007). It may be biologically and technically feasible to manage, restore and mitigate threats to habitat for the Hine's Emerald in and around the Minesing Wetlands such as alterations to hydrology and invasive species to help maintain the existing population, and support the species long-term persistence in Canada.

***Population Connectivity***

Connectivity among local populations can be important in naturally restoring depleted populations. If connectivity between habitat patches is decreased (e.g., through habitat loss or population declines), remaining local populations may be too small to be viable on their own, or may become inbred due to a lack of gene dispersal. In determining the appropriate level of population connectivity required to ensure survival or recovery of the species in Canada, it is important to consider the historical level of connectivity to which the species is adapted.

Although it is not known if additional populations of the Hine's Emerald existed in Canada historically, landscape scale changes across southern Ontario have isolated the Minesing Wetlands' population from the next closest population in Michigan. The Minesing population will likely continue to occur as a highly isolated population, unless future

survey efforts discover nearby populations. Natural dispersal and colonization to this area is unlikely because dispersal distances for the species are believed to be very limited (< 50 km) and the nearest population is in Michigan (USFWS 2001).

Corridors between habitat patches are important for movement and dispersal of the Hine's Emerald (Foster and Soluk 2004), which allows it to progress through its life stages. Local drainage and development activities, particularly around the periphery of the Minesing Wetlands may also have affected connectivity within the current Hine's Emerald population.

If changes to hydrology result in changing water levels and succession in the Minesing Wetlands and adjacent forested areas are eliminated, the amount of contiguous suitable habitat available to the Hine's Emerald for its life stages will be reduced. With the existing protection under the provincial Planning Act, however, it is unlikely that fragmentation could become so extensive as to limit adult Hine's Emeralds from dispersing within the wetland complex.

#### ***Mitigation of Human-caused Threats***

This criterion refers specifically to those threats, as a result of human activity, that significantly increase risk to the species. The major threats to the Hine's Emerald are generally well known and an appropriate level of habitat conservation and threat mitigation would reduce the risk associated with these threats; however, some of these are not considered reversible and are ongoing. Maintaining the current water balance and water quality in and around the Minesing Wetlands' population and monitoring and controlling European Common Reed (*Phragmites australis australis*) within Hine's Emerald habitat are considered the most effective methods to mitigate current threats. These actions will benefit the wide variety of species that inhabit the Minesing Wetlands and surrounding forested areas and not just the Hine's Emerald.

#### ***Representation in Appropriate Ecological Communities***

The distribution of the Hine's Emerald across its range is extremely localized and limited to marshes, fens and nearby forested areas. Fens are rare in southern Ontario (Bowles et al. 2007). The species has been recorded regularly in the Minesing Wetlands since 2007, but the abundance of the Hine's Emerald within Canada is unknown (COSEWIC 2011). It is possible, however, that additional populations could be discovered through additional surveying at other suitable habitat locations in Ontario (Pulfer et al. 2013).

#### ***Independent of Connectivity with Populations Outside of Canada***

While some species have always been reliant on connectivity with populations outside Canada, the presence of the Great Lakes and large expanses of land without suitable habitat make it highly unlikely that the Canadian population of the Hine's Emerald was historically reliant on populations outside Canada for survival. The reliance of historically precarious species on populations that are not at risk or which occur outside of Canada is not considered an obstacle to survival. Regardless, the Canadian population of Hine's Emerald is not considered to be connected with populations in the United States.

***Independent of Species Interventions***

It is expected that the persistence of the Hine's Emerald will be independent of continuous human interventions; however, habitat management will likely be required periodically such as controlling invasive species (i.e. European Common Reed), to help maintain habitat suitability.

## Appendix B: Conservation Status Ranks of the Hine's Emerald (*Somatochlora hineana*)

Table B-1. Ranks of the Hine's Emerald (NatureServe 2017).

Hine's Emerald ( <i>Somatochlora hineana</i> )				
Global (G) Rank	National (N) Rank (Canada)	Subnational (S) Rank (Canada)	National (N) Rank (United States)	Subnational (S) Rank (United States)
G2G3	N1	Ontario (S1)	N2N3	Alabama (SH), Illinois (S1), Indiana (SX), Michigan (S1), Missouri (S2), Ohio (SX), Wisconsin (S1)

### Rank Definitions (NatureServe 2017)

**G2G3/N2N3: Vulnerable/Imperilled:** The risk of extirpation in the jurisdiction ranges from moderate to high due to a fairly restricted to restricted range, relatively few to few populations or occurrences, recent and widespread to steep declines, moderate to severe threats, or other factors.

**N1/S1: Critically Imperilled:** At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

**S2: Imperilled:** At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

**SH: Possibly Extirpated (Historical):** Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become NH or SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The NH or SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.

**SX: Presumed Extirpated:** Species or community is believed to be extirpated from the nation or state/province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

## Appendix C: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>28</sup>. 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 any of the [Federal Sustainable Development Strategy](#)'s<sup>29</sup> (FSDS) 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 strategy itself, but are also summarized below in this statement.

In general, protecting the habitat of the Hine's Emerald will benefit other native plant and animal species, such as Bog Buckbean (*Menyanthes trifoliata*), Twig Rush (*Cladium mariscoides*), sedges (*Carex limosa*, *C. livida*, *C. chordorrhiza*), and Common Bog Arrow-grass (*Triglochin maritima*) as well as several species at risk such as Eastern Prairie Fringed-orchid (*Platanthera leucophaea*), Blanding's Turtle (*Emydoidea blandingii*) Great Lakes/St. Lawrence population, Northern Map Turtle (*Graptemys geographica*), Snapping Turtle (*Chelydra serpentina*), Cerulean Warbler (*Setophaga cerulean*), Canada Warbler (*Cardellina canadensis*), and Least Bittern (*Ixobrychus exilis*). The whole of the Minesing Wetland complex is a Provincially Significant Wetland, an Area of Natural and Scientific Interest (both provincial designations), a Ramsar Site (wetland of international importance), and an important staging area for waterfowl.

Measures recommended in the *Hine's Emerald – Ontario Government Response Statement* (Part 3) and adopted by Environment and Climate Change Canada will benefit other species and habitats as noted above, through the development of best management practices to promote protection of wetlands and upland groundwater infiltration, controlling the European Common Reed and other invasive plant species, and development and implementation of habitat monitoring (Actions 1 through 3 in the provincial Government Response Statement for this species).

The potential for the strategy to inadvertently lead to adverse effects on other species was considered. None of the management activities proposed are activities that would negatively affect other species. The SEA concluded that this strategy will clearly benefit the environment and will not entail significant adverse effects.

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<sup>28</sup> [www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html](http://www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html)

<sup>29</sup> <https://www.fsds-sfdd.ca/index.html#/en/goals/>

**Part 2 – *Recovery Strategy for the Hine’s Emerald*  
(*Somatochlora hineana*) in Ontario, prepared by Pulfer et al.  
(2013) for the Ontario Ministry of Natural Resources**



# Hine's Emerald

*(Somatochlora hineana)* in Ontario

## Ontario Recovery Strategy Series

Recovery strategy prepared under the Endangered Species Act, 2007

*Natural. Valued. Protected.*

# About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act (ESA) and the Accord for the Protection of Species at Risk in Canada.

## What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

## What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

## What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

## For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: [www.ontario.ca/speciesatrisk](http://www.ontario.ca/speciesatrisk)

## RECOMMENDED CITATION

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**Cover illustration:** Mature male Hine's Emerald two kilometres southeast of Minesing Wetlands. C.G. Evans 2010.

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*Cette publication hautement spécialisée Recovery strategies prepared under the Endangered Species Act, 2007, n'est disponible qu'en Anglais en vertu du Règlement 411/97 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec Cathy Darevic au ministère des Richesses naturelles au 705-755-5580.*

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- Dan Soluk (University of South Dakota)

## **DECLARATION**

The Ontario Ministry of Natural Resources has led the development of this recovery strategy for the Hine's Emerald in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

## **RESPONSIBLE JURISDICTIONS**

Ontario Ministry of Natural Resources  
Environment Canada, Canadian Wildlife Service - Ontario

## EXECUTIVE SUMMARY

Hine's Emerald (*Somatochlora hineana*) is a globally rare dragonfly restricted to southern Ontario, Wisconsin, Michigan, Illinois and Missouri. In Ontario it is only known to occur in the Minesing Wetlands located in the County of Simcoe. It is listed as endangered under Ontario's *Endangered Species Act, 2007* due to its habitat specificity, potential threats and extremely limited geographic range. It has also been listed as endangered or extirpated throughout its known global range.

The key features used to distinguish Hine's Emerald from other similar species are the unique conformations of its sexual appendages or genital plates on the end of the abdomen, dark metallic green thorax with two creamy yellow lateral stripes and its relatively large size (60-65 mm long and 90-95 mm wingspan).

Hine's Emerald is restricted throughout its range to calcareous wetlands (marshes, sedge meadows and fens) dominated by graminoid vegetation and fed primarily by groundwater seeps. Adult males occur in seepage areas and fens and adjacent margins, whereas females are usually found in dry meadows, sometimes in adjacent forest openings, only coming into wetlands to lay eggs. Adults may also utilize adjacent forests, gravel roads, trails and fields for foraging before returning to the wetlands to mate and lay eggs. Hine's Emerald deposit eggs in shallow channels or sheetflow in areas of herbaceous vegetation in marshes, meadow marshes and fens. The larvae remain in cool, shallow, slowly-moving waters of spring-fed marshes, alkaline fens, mineral-rich fens with shallow creeks, springs, small pools, marl deposits and calcareous marshy streams for three to five years before emerging as adults. In some locations, larvae use crayfish burrows, mainly of Digger Crayfish or of Devil Crawfish (also known as Meadow Crayfish), as refuge habitat in the summer and winter months. Crayfish burrows are thought to be a critical component of Hine's Emerald habitat where seasonal drought and freezing occurs and may be a factor limiting its distribution.

The main threats to this species in Ontario are habitat loss due to changes in surface and sub-surface hydrology (including water quality), competition from invasive species (Garlic Mustard, Purple Loosestrife, Glossy Buckthorn and the non-native genotype of Common Reed) and vegetation succession from native species. The inter-species dependency of Hine's Emerald on Digger Crayfish indicates that threats to the persistence of burrowing crayfish in Ontario would have a severe negative effect on Hine's Emerald.

The recovery goal for Hine's Emerald is to prevent any loss of population, genetic diversity or habitat functionality at extant sites or at any other extant locations which may be identified in the future in Ontario.

The recovery objectives outlined to achieve this goal are as follows:

- protect and maintain the quantity and quality of Hine's Emerald habitat and habitat functionality, including the hydrological and hydrogeological function;
- reduce or mitigate threats to Hine's Emerald and its habitat;

- increase knowledge of Hine's Emerald biology in Ontario including distribution, abundance, life history and habitat needs; and
- increase public awareness and understanding of Hine's Emerald and its habitat in Ontario.

It is recommended that the area regulated as habitat include all extant locations. In Ontario, this currently includes only the Minesing Wetlands. In order to protect both the adult and larvae stages of Hine's Emerald, it is recommended that the area prescribed as habitat include fen and wetland meadows, (i) where Hine's Emerald have been observed and (ii) that are connected by surface or ground water to areas where Hine's Emerald have been observed. In addition to these areas the prescribed habitat should also include 500 metres beyond each of these habitats. For the purposes of perching, movement and roosting, all forests and dry meadows that are adjacent to the areas described above should also be prescribed as habitat.

To allow for migration and dispersal between habitat patches used by Hine's Emerald it is recommended that corridors connecting the habitat areas described above be prescribed as habitat. Corridors are believed to be both natural (creeks, swales and other water features) and anthropogenic features (trails, utility rights-of-way and gravel roads) that have forested edges or riparian habitat.

Due to the dependence of Hine's Emerald habitat on groundwater recharge it is recommended that prescribed habitat include the Snow Valley Uplands, where the current regional groundwater infiltration regime is maintained for the entire Minesing Wetlands.

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## 1.0 BACKGROUND INFORMATION

### 1.1 Species Assessment and Classification

COMMON NAME: Hine's Emerald

SCIENTIFIC NAME: *Somatochlora hineana*

SARO List Classification: Endangered

SARO List History: Endangered (2012)

COSEWIC Assessment History: Endangered (2011)

SARA Schedule 1: No Schedule, No Status

CONSERVATION STATUS RANKINGS:

GRANK: G2G3

NRANK: N1

SRANK: S1

The glossary provides definitions for technical terms, including the abbreviations above.

### 1.2 Species Description and Biology

#### Species Description

Hine's Emerald (*Somatochlora hineana*) is a dragonfly in the Family Corduliidae (Order Odonata), more commonly known as Emeralds. Emeralds are characterized by their brilliant emerald green eyes (USFWS 2001).

Identification of adults in flight is difficult between species of the Emerald family, particularly of the genus *Somatochlora*. These species are generally very difficult to track in flight as they are extremely swift, erratic and agile. They have excellent evasive abilities and cryptic colouration. Hine's Emerald tends to fly high, often in dappled shade. However, in the United States they are often observed flying low over the breeding habitat during male terrestrial patrols and female oviposition flights, making identification discernible with aid of binoculars (P. McKenzie, pers. comm. 2012). In Ontario, the habitat of Hine's Emerald is quite rare and often remote, making access very difficult. These attributes make this species very difficult to locate and even harder to capture and identify (C.G. Evans pers. obs.).

The most similar species to Hine's Emerald are the Clamp-tipped Emerald (*S. tenebrosa*), Williamson's Emerald (*S. williamsoni*) and the female Brush-tipped Emerald (*S. walshii*). The key features that distinguish Hine's Emerald from these other species are its unique conformation of sexual appendages of the male and genital plates of the female on the end of the abdomen, either the terminal appendages (or claspers) for males or the ovipositor (or genital plates) for females. These features are readily

discernible in the hand but rarely in flight (USFWS 2001). Other features used to distinguish adults from other species in the genus *Somatochlora* with similar sexual appendages include its dark metallic green thorax with two creamy yellow lateral stripes, and its relatively large size (60-65 mm long and 90-95 mm wingspan).

The larvae or nymphs of different species in the genus *Somatochlora* are extremely similar, and reliable identification can only be made in final instar larvae using characteristics observable only under a microscope (Cashatt and Vogt 2001). The only identification key available that includes Hine's Emerald describes the final instar larvae only (Cashatt and Vogt 2001). Thus, accurate identification of earlier instars is not possible except by genetic analyses, but such analyses have not been undertaken in Ontario (P. McKenzie and T. Cashett, pers. comm. 2012).

### Species Biology

Similar to other dragonflies, Hine's Emerald undergoes incomplete metamorphosis involving three stages: aquatic egg, aquatic larva (nymph) and terrestrial/aerial adult (COSEWIC 2011). The majority of the three to five year lifespan of Hine's Emerald is spent in the aquatic larval stage (COSEWIC 2011). During this stage, they are thought to be opportunistic sit-and-wait predators that prey upon small aquatic invertebrates including mayflies (Ephemeroptera), caddisflies (Trichoptera), oligochaete worms, and also likely upon isopods, smaller dragonfly larvae, mosquito larvae, other worms, snails and even small fish (USFWS 2001, COSEWIC 2011).

As water temperatures drop in the fall, the larvae become less active and little is known about their overwintering ecology. However, in the summer and winter months they have been found inside crayfish burrows (COSEWIC 2011). During the larval period, Hine's Emerald larvae grow and molt several times before they reach their final instar. Hine's Emerald larvae appear to be physiologically well adapted to survive periodic conditions of drought (USFWS 2001, COSEWIC 2011).

Once in their final instar, larvae climb from the water onto emergent vegetation for their final transformation into adults. Emergence of Hine's Emerald dragonflies continues throughout the summer and peak emergence in Ontario occurs for two to three weeks in early to mid-June (COSEWIC 2011).

Newly-emerged adults seek out protection in vegetation, where over a period of a few days, their bodies harden and their sexual organs mature (Corbet 1999). Prior to reproducing (the pre-reproductive stage), adults spend 7 to 10 days aerially foraging on gnats, mosquitoes and other small flying insects (USFWS 2001). During this pre-reproductive stage, they may forage up to three kilometres away from their larval habitats, foraging most actively in the morning but continuing throughout the day and possibly into dusk (USFWS 2001). Foraging may occur over open fields and wet or dry meadows, along hedgerows or forest margins, or along narrow roads. Foraging flight varies from fast, low (less than two metres), along roads or trails up to one kilometre long, to slow, high (treetop height), circuitous floating flights near forest/meadow margins (USFWS 2001).

During the reproductive stage, which is approximately two to four weeks long, adult males establish small territories near forests or swamps suitable for mating and near aquatic habitat suitable for ovipositing (Cashatt and Vogt 1990, Vogt and Cashatt 1994). Insufficient data on natural breeding exist to date to delineate the breeding season for the Ontario population. However, based on the breeding season for Hine's Emerald in the climactically similar zone of Michigan, the breeding season in Ontario likely extends from late June to late July (MOS Tech. Note # 3, 2001). Adults also continue to forage, flying up to two kilometres away from their breeding sites (Cashatt and Vogt 1990, Vogt and Cashatt 1994). Males defend their territories making fast flights back and forth and occasionally hovering over territories that range in size from two to four square metres (Cashatt and Vogt 1990, Vogt and Cashatt 1994). A female entering a male's territory is intercepted by the male and mating occurs on nearby vegetation (Cashatt and Vogt 1990, Vogt and Cashatt 1994). After fertilization, the females then repeatedly insert the tip of their abdomens into mud or shallow water, ovipositing up to 200 eggs (COSEWIC 2011).

The adult lifespan of Hine's Emerald is typically four to six weeks (Zercher et al. 2001) but may extend up to a maximum of a few months; i.e., seven to ten days pre-reproductive, two to four weeks reproductive and up to several weeks post-reproductive (COSEWIC 2011).

Hine's Emerald dragonflies are vulnerable to predation during all life stages. Aquatic larvae may be eaten by larger predatory insects (e.g., larger dragonfly larvae), crayfish, amphibians, fish, wading birds, shorebirds, dabbling ducks and turtles (USFWS 2001). Emerging larvae are vulnerable to predation by birds and frogs. Adults, particularly soft, poorly flying newly-emerged adults, are also susceptible to predation by birds and frogs as well as to spiders and even larger dragonflies (USFWS 2001).

### **1.3 Distribution, Abundance and Population Trends**

Hine's Emerald is endemic to North America and is listed as endangered or extirpated throughout its entire distribution. In the United States of America, the species is known to occur in the states of Wisconsin, Michigan, Illinois and Missouri (Figure 1). Historically, the species was known from the states of Ohio, Indiana and Alabama (Figure 1; Vogt and Cashatt 1994, COSEWIC 2011). In Canada, the species is known only from a single location in southern Ontario – the Minesing Wetlands and immediately adjacent areas (Figure 1). Based on COSEWIC convention, the extent of occurrence for this site is considered to be 28 km<sup>2</sup> (COSEWIC 2011).

The Ontario occurrence is thought to contain a single population (COSEWIC 2011), hereby referred to as the Minesing Wetlands population. Minesing Wetlands is located in the County of Simcoe, located between the towns of Barrie and Wasaga Beach. It had been suspected that Hine's Emerald may be present in Ontario due to presence of similar habitats found at known sites in the United States. This led to targeted surveys

between 1999 and 2002, all of which resulted in negative findings (COSEWIC 2011). In June 2007 a single male was observed and photographed by a local naturalist of Minesing Wetlands (report co-author, Christopher Evans) and identified by Colin Jones (Ontario Ministry of Natural Resources, OMNR). Significant survey efforts in 2007 to 2009 resulted in additional captures of adults and nymphs at Minesing Wetlands, providing a better delineation of adult and larval habitat ranges. Twenty-eight other sites that were identified as having appropriate habitat were searched (see COSEWIC 2011 for details). Although Hine's Emerald have not been found at these sites to-date, it should be noted that negative survey results are not uncommon for this species where it is extant (COSEWIC 2011). Experts suggest there is a high likelihood of extant Hine's Emerald populations at least at some of these twenty-eight locations. Further surveys are necessary to investigate this possibility.

Species abundance of the Ontario population is currently unknown. Mark-recapture methods have been used to estimate adult populations ranging from 1,710 (Lockport Prairie, Illinois) to 118,140 (the Ridge Sanctuary, Wisconsin) at other locations. However, these methods are not thought to be appropriate for long-term monitoring (Soluk et al. 1998 in COSEWIC 2011) and there are currently no known recommendations for population estimates that are suitable for long-term monitoring.

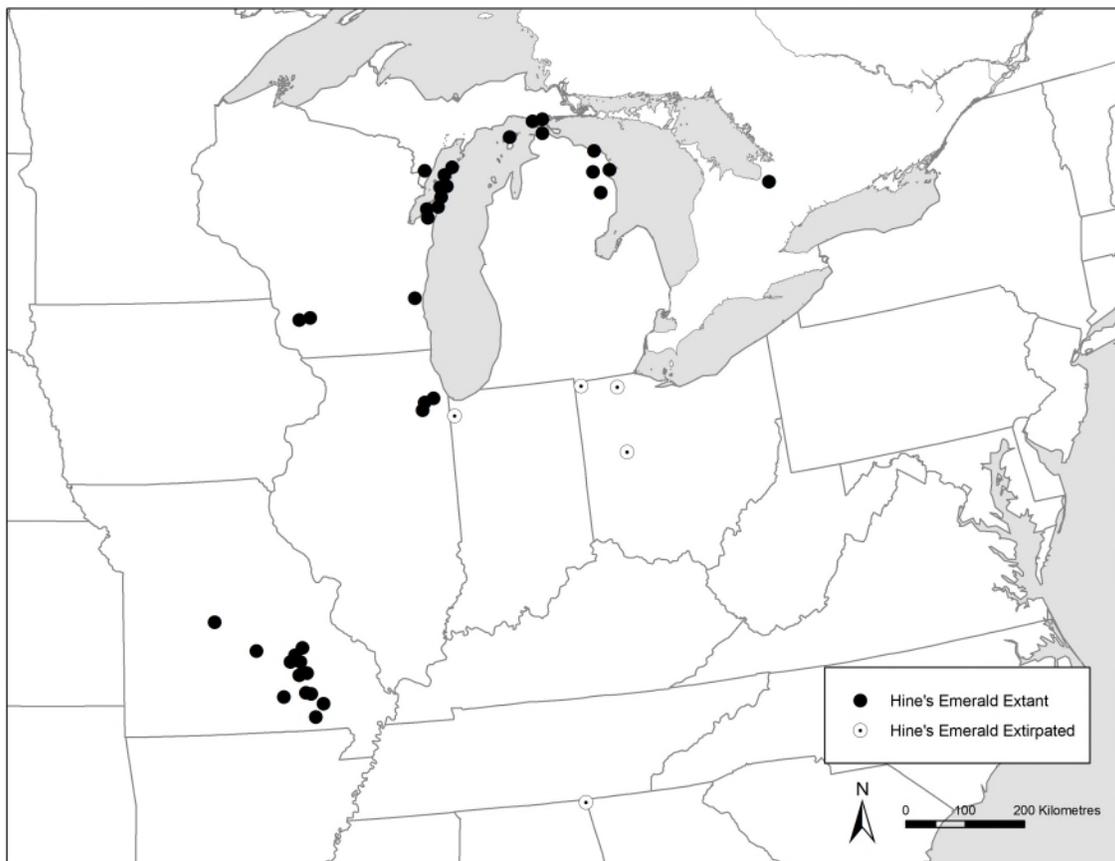


Figure 1. Extant and extirpated locations of Hine's Emerald in North America (adapted from COSEWIC 2011).

## 1.4 Habitat Needs

Hine's Emerald is a species found in calcareous wetlands including marshes, meadow marshes and fens dominated by graminoid vegetation (particularly sedges) which are fed primarily by groundwater from intermittent seeps (COSEWIC 2011). Most sites also have an underlying layer of shallow dolomitic bedrock (Cashatt and Vogt 2001).

Limestone bedrock of the Verulam Formation underlies the Minesing Wetlands at a depth of 60 to 90 metres (Hanna 1982) which is atypical for Hine's Emerald sites, however thick glaciolacustrine silts and clays underlay the wetland complex (Post 2009). These deposits act as an impermeable layer which directs seepage flows from the adjacent bluffs laterally (northwest) through the fen thereby providing hydrogeological conditions which are similar to the shallow bedrock sites where Hine's Emerald is found in the United States (Post 2009, COSEWIC 2011).

Hydrogeochemical analysis of Minesing Wetlands groundwater indicates that the fen is dominated by calcium and bicarbonate ions with the postulated source being from deep groundwater or mineral soils below the peat, regionally originating from the outcropping aquifers at the stranded glacial shoreline deposits and through shallow peat (Bradford 1999). Groundwater discharge along the eastern margin could account for the observed hydrogeochemical trends from the bluffs towards the fen along the principal direction of groundwater flow (Bradford 1999).

Adults use various habitats for foraging, resting, breeding and movement. As discussed in the species biology section, adults forage and breed in wet habitats such as marshy areas and open water. This includes habitats such as cattail seepage marshes, seepage sedge meadows, sedge hummocks near marshy stream edges, swales, muck, sluggish water at the edge of springs, small puddles, streamlets and in marl/muck bottomed pools (COSEWIC 2011). Adjacent forest areas provide protected, shaded areas for perching and roosting (USFWS 2001). Corridors between habitat patches are essential for movement and dispersal. Areas used as corridors include marshes, sedge meadows, dolomite prairie, fringing shrubby and forest areas bordering wetlands (Foster and Soluk 2004).

There are some observed differences in habitat use between male and female Hine's Emerald. Generally, adult males of this species occur in seepage areas and fens, whereas the females are usually found in dry meadows, only coming into wetlands and aquatic habitat to lay eggs (Foster and Soluk 2006). Adult females deposit eggs in shallow channels or sheetflow in areas of herbaceous vegetation in marshes, meadow marshes and fens (Cashatt and Vogt 2001). Soil types range from organic muck to mineral soils such as marl (COSEWIC 2011). It should be noted that to date there have been no observations of Hine's Emerald laying eggs in Ontario.

In Ontario, the known habitat of Hine's Emerald is restricted to the Minesing Wetlands and immediately adjacent areas, where adults have been found in open string fen areas (elongated openings), fallow farm fields, forests, trails and roadside openings

(COSEWIC 2011). The habitat in the open fens of Minesing Wetlands is dominated by herbaceous plants and include, Bog Buckbean (*Menyanthes trifoliata*), Twig Rush (*Cladium mariscoides*), Beaked Spike-rush (*Eleocharis rostellata*), sedges (such as *Carex limosa*, *C. livida*, *C. chordorrhiza*), Common Bog Arrow-grass (*Triglochin maritima*) and the native Common Reed (*Phragmites australis* ssp. *americanus*). “String islands” of Tamarack (*Larix laricina*) and Eastern White Cedar (*Thuja occidentalis*) swamp forest lie adjacent to these open fen habitats (COSEWIC 2011).

Larvae are found in cool, shallow, slowly-moving waters of spring-fed marshes, alkaline fens, mineral-rich fens with shallow creeks, springs, small pools, marl deposits and calcareous marshy streams (Pintor and Soluk 2006). In the northern United States, Hine's Emerald larvae often inhabit crayfish burrows to seek refuge, especially during drought periods (Pintor and Soluk 2006). In Missouri, Hine's Emerald larvae have only been found in crayfish burrows (P. McKenzie, pers. comm. 2012). The burrows used have been found to belong to semi-terrestrial crayfish [i.e., Devil Crawfish (also referred to as Meadow Crayfish, *Cambarus diogenes*) in the United States and Digger Crayfish (*Fallicambarus fodiens*) in the Minesing Wetlands (COSEWIC 2011)]. The presence of crayfish burrows likely represents a critical component of Hine's Emerald habitat, possibly limiting its distribution from otherwise suitable sites (Pinto and Soluk 2006, COSEWIC 2011).

Digger Crayfish construct fairly complex burrows mainly in wetlands but also in roadside ditches, temporary bodies of water and creek banks (Guaşu 2007, Crandall 2010). These burrows are often made in clay or muck soils with the mud chimneys being the only portion exposed above ground (Guaşu 2007). Despite Digger Crayfish being the most wide-spread species of the Cambaridae family, occurring in 21 states and one province (Ontario), it is not locally common and occurs in isolated patches (Guaşu 2007).

## 1.5 Limiting Factors

The low number of extant populations and restricted range in North America emphasizes the extremely narrow habitat preferences of Hine's Emerald. Fen habitats like those associated with the Minesing Wetlands population comprise less than a fraction of one percent of the total wetland area south of the Canadian Shield in Ontario (Riley 1989) and suitable community types of sufficient size are found in only a portion of these habitats.

Despite significant searches for additional populations in south-central Ontario, Minesing Wetlands remains the only known population in Ontario and Canada. Though negative survey results do not necessarily suggest absence of other small populations, the negative results to date suggest that Hine's Emerald may only occur at very few additional Canadian locations (COSEWIC 2011).

It is likely that the presence of crayfish burrows and perhaps burrows related to particular crayfish species may be a limiting factor to Hine's Emerald distribution.

## 1.6 Threats to Survival and Recovery

### Alteration of Hydrology (high threat)

Reduced groundwater inputs associated with proposed development or climate change could directly impact Hine's Emerald breeding sites by reducing the water necessary to maintain larval habitat (COSEWIC 2011). Minesing Wetlands is a provincially and internationally significant wetland, thus it is afforded protection under Ontario's *Planning Act – Provincial Policy Statement*<sup>1</sup>. However, depending on the type of adjacent land use, activities may still alter the hydrology of the wetland. Land use in this upland area currently comprises agriculture and low to medium intensity rural residential developments.

The fen habitats in Minesing Wetlands are sustained primarily by groundwater seepage. Maintenance of current hydrogeological functions that support Hine's Emerald habitat is dependent on effective management of recharge areas in the adjacent uplands (Post et al. 2010). Any changes to surface and sub-surface hydrology that affect the quantity of groundwater flow are likely to negatively impact larval habitat and consequently reduce populations of Hine's Emerald (USFWS 2001).

Snow Valley Uplands<sup>2</sup> is the recharge area that supports the groundwater aquifer feeding the east portion of the Minesing Wetlands (Post 2009). This groundwater system provides the framework for wetland habitats that support Hine's Emerald, as well as habitat for other sensitive species at risk. Portions of the upland recharge area are designated for current and proposed residential development (Township of Springwater Official Plan 1998 and County of Simcoe Official Plan 2007) that could reduce the quantity of groundwater recharge through creation of impermeable surfaces. Additionally, municipal water supplies from local wells may also reduce the quantity of groundwater moving toward Minesing Wetlands. Reduced recharge and increased water-taking could potentially impact groundwater seepages at the base of the bluffs that support Hine's Emerald habitat (Post pers. obs.).

Climate change may also potentially impact hydrogeological conditions that support Hine's Emerald habitat (Davies and Simonovic 2005). Winter and summer air temperatures are expected to increase over time (Portmann et al. 2009). Precipitation trends are less certain, although most models indicate an increase in extreme events (droughts and floods) and "flashier" storm events (Zedler 2010). Projected increases in wind speeds could increase evapotranspiration in the Lake Huron basin (Snyder et al. 2011). Any one factor or a combination of these factors could decrease the volume of

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<sup>1</sup> The Planning Act – Provincial Policy Statement protects the area deemed provincially significant and up to 120 meters surrounding this area

<sup>2</sup> See Figure 1.1 in Spoelstra and Post 2012 for a description of the Snow Valley Uplands.

precipitation and runoff recharging the Snow Valley Upland aquifer and the resulting seepage in the Minesing Wetlands.

Altered hydrology can also lead to vegetation succession. Succession is restricted based on hydrological conditions in the open fen of Minesing Wetlands. If the hydrology is altered, succession may reduce the availability of suitable breeding and larval habitat. Thus, indirectly, reduced groundwater flows across the open fen habitats could impact Hine's Emerald breeding sites by changing the composition of the vegetation community (COSEWIC 2011). Open graminoid fen sites could shift to shrub fen or conifer swamp communities. This would reduce the amount of appropriate larvae and breeding habitat for Hine's Emerald.

#### Contamination of Groundwater (low threat)

Contamination of groundwater is a potential threat to Hine's Emerald habitat (USFWS 2001). The permeable sands and gravels associated with the Snow Valley Uplands provide a potential conduit for contaminants to enter the underlying aquifer which feeds the Minesing Wetlands. Road salt, agricultural pesticides, agricultural fertilizers, faulty septic beds and urban contaminants are potential contaminant sources that could impact groundwater quality (Post 2009). Recent investigations indicate that slightly elevated levels of nutrients (likely from agricultural activities) and sodium/chloride (from road salt) are present in groundwater at the periphery of the Minesing Wetlands (Spoelstra and Post 2012). Although current levels are considered too low to pose a risk to ecological functions and do not persist into the open fen habitats, these elevated levels strongly indicate the link between upland recharge areas and groundwater discharge to the Minesing Wetlands. Thus, this has the potential to become a high threat to Hine's Emerald and its habitat.

#### Invasive Species (medium threat)

Invasive species represent another potential impact to Hine's Emerald habitat. Approximately 14 percent of the plants documented in the Minesing Wetlands area are introduced (Bowles et al. 2007). The main species of concern include Garlic Mustard (*Alliaria petiolata*), Purple Loosestrife (*Lythrum salicaria*), Glossy False Buckthorn (*Frangula alnus*) and the non-native genotype of Common Reed (*Phragmites australis* ssp. *australis*). These species have been known to act dominantly in certain ecosystems such as wetlands and forests, reduce habitat quality for sensitive native wildlife and compete with and directly exclude other native plants (Meekins and McCarthy 1999, Catling and Mitrow 2009, COSEWIC 2011). Of particular concern are the non-native Common Reed and Glossy Buckthorn, which are expanding throughout Ontario at an exponential rate. In the Minesing wetland, the non-native Common Reed has been documented around the periphery of the wetland complex, while the native Common Reed is found only in the fen portion of the wetland. While Glossy Buckthorn is not currently known within the Minesing Wetlands area, like the non-native Common Reed, it is also expanding rapidly in southern Ontario. If either of these non-native species continue to move into the open fen area of Minesing Wetland, this could significantly impact the open fen habitat and restrict or eliminate burrowing crayfish activity in current Hine's Emerald breeding sites.

#### Road Mortality (low threat)

Dragonflies are susceptible to road mortality (Rao and Girish 2007, Soluk et al. 2011), however the extent to which Hine's Emerald is impacted by road mortality in Ontario is unknown. Hine's Emerald does not seem to avoid roads, and may in fact use them as corridors (Soluk et al. 2011, C.G. Post pers. obs.). Dragonfly road mortalities generally happen in two stages: (i) dragonflies that are hit by cars exceeding 50 to 60 km/h experience severe shock and fall to the ground; (ii) dragonflies either recover from the shock and fly away or, as is usually the case, they are run over by a second vehicle (Rao and Girish 2007). This coupled with the distribution of carcasses (usually in vehicle grills), make quantifying this threat difficult.

Soluk and Moss (2003) conducted a road mortality study of a Hine's Emerald population in Wisconsin. They estimated that dragonfly road mortality rates were roughly 16 per day, and a minimum estimate of 699 per year.

Several roads surrounding Minesing Wetlands have been observed as active foraging habitat for both male and female Hine's Emerald and Harlequin Darners (*Gomphaeschna furcillata*; C.G. Evans pers. obs.). Male Hine's Emerald commonly patrol these routes in what are thought to be territorial patrols at heights of between one and two metres, which may make them vulnerable to road mortality (C.G. Evans pers. obs.). Adult females appear to forage mainly at heights greater than three metres in these areas and thus are not particularly susceptible to significant road mortality. However, one injured teneral female Hine's Emerald was removed from the surface of Portage Trail, apparently a victim of a collision with a vehicle (C.G. Evans pers. obs.). Little research has been conducted on the effects of road mortality on dragonflies and so the exact impact of this threat on the Canadian Hine's Emerald population is unknown.

#### Anthropogenic Disturbance to Habitat (low threat)

Fen habitats are sensitive to human disturbance, such as trampling. Unrestricted access to these habitats could impact the open fen habitats that support Hine's Emerald in the Minesing Wetlands. Disturbance of the fen habitat by all terrain vehicles (ATVs) is currently not an issue due to restricted vehicle access in the fen as well as the difficulty of the terrain. All terrain vehicles could be of potential threat to adult Hine's Emerald along the trail networks in Minesing Wetlands; the trails have restricted access but this is not easily enforced as many land owners use the trails to access their properties in Minesing Wetlands.

#### Direct human-caused mortality (unknown)

The exact threat from direct mortality, such as collections, is unknown. Dragonflies have longer breeding periods and generally smaller population sizes than many other insects (Soluk et al. 2011). Therefore direct mortality of an individual will likely have a larger impact on the overall population compared to species with short breeding periods and larger population sizes.

## 1.7 Knowledge Gaps

### Population Size and Range

Hine's Emerald abundance in Ontario is unknown. Further, other population sizes in North America are relatively unknown. A standardized, repeatable population estimate technique is required to understand baseline populations and future trends. Adults are generally encountered during focused surveys during their summer flight period (COSEWIC 2011). Despite efforts being made to mark and recapture individuals, this technique is not favoured (COSEWIC 2011). Removal method and use of exuviae have been suggested as other potential population estimate techniques (Foster and Soluk 2004, COSEWIC 2011). However, this has proved to be unsuccessful in the Midwest United States, where there are too few exuviae or larvae to use such a method (P. McKenzie, pers. comm. 2012).

In Ontario, focused surveys from 2007 to 2009 have provided further insight into the range of Hine's Emerald in the vicinity of the Minesing Wetlands but the full extent of the population range in Minesing has likely not been fully determined to date.

Other extant populations of Hine's Emerald may be present in southern Ontario. Although focused survey efforts have failed to find any other populations, Hine's Emerald can be very difficult to find, especially in areas with small populations (COSEWIC 2011). New populations in Missouri were found only after two to three years of surveys by experts (P. McKenzie, pers. comm. 2012). Additional surveys in suitable habitats elsewhere in southern Ontario may be warranted to search for additional populations.

### Dispersal

Based on current knowledge, it is unknown if any dispersal is happening between Minesing Wetlands and other Hine's Emerald populations. It is unknown how far Hine's Emerald can travel. Currently, the maximum recorded dispersal distance of an individual is 5.4 km (COSEWIC 2011). However, there are genetic studies that link populations together over larger distances. The evidence so far suggests that these dispersal events were relatively recent (approximately 4000 years ago during the Pleistocene age) leading experts to suggest that dispersal distances would be larger than the current observed maximum distance (5.4 km).

### Habitat Requirements

Hine's Emerald habitat in Ontario differs from that of the populations in the United States. Similarities between sites include the importance of groundwater to Hine's Emerald habitat and the use of crayfish burrows by larvae. The populations in the United States are found in areas of shallow soil over the bedrock, whereas Minesing Wetlands has a deep layer of soil over bedrock. Thus, questions arise as to what habitat features Hine's Emerald are selecting for.

There is uncertainty about how the hydrogeological processes provide critical support for Hine's Emerald habitat in the Minesing Wetlands. Although recent hydrogeological studies (e.g., Post 2009, Post et al. 2010, Spoelstra and Post 2012) have provided important baseline information on wetland hydrogeology (groundwater levels and chemistry), a regular, dedicated monitoring program is required to fully understand seasonal habitats and to identify trends over time. Hydrogeological conditions associated with the recharge area that feeds the groundwater system which, in turn, support Hine's Emerald habitat are not well known.

#### Inter-species Interactions

It appears that Hine's Emerald use crayfish burrows during the larval phase of their lifecycle (USFWS 2001, COSEWIC 2011), but the nature and extent of this use is not yet understood. Studies in the United States have determined that Hine's Emerald use Devil Crawfish burrows (USFWS 2001), whereas investigations in Ontario have found Hine's Emerald in Digger Crayfish burrows (COSEWIC 2011). It is unknown if these are the only two crayfish species' burrows that Hine's Emerald use for larval habitat. It is unknown whether or not this use of burrows is obligatory, opportunistic or incidental in Minesing Wetlands, however, it has been shown to be beneficial and likely obligatory at one site in the United States (Pintor and Soluk 2006). Further study of the interaction between Hine's Emerald and burrowing crayfish in Minesing Wetlands habitats would potentially be valuable in locating other extant populations of Hine's Emerald in Ontario and Canada and in identifying and restoring historical habitats.

#### Identified Threats.

Most of threats listed above are not fully understood. While most experts agree that the listed threats are valid, the degree of impact (current and/or future) is uncertain. Of note are the exact threats from direct human-related mortalities and road mortalities to this population.

## **1.8 Recovery Actions Completed or Underway**

#### Population Size and Range

In 2007 to 2009, relatively intensive Hine's Emerald (adult) surveys were undertaken in fen and boreal swamp habitats as well as upland habitats along the eastern periphery of the Minesing Wetlands. Larval habitats (crayfish burrows) were sampled and confirmed in 2008 (COSEWIC 2011). These surveys have assisted with identification of the range of Hine's Emerald habitat in Minesing Wetlands, although additional surveys may be required to document the full extent of the population range.

#### Genetic Studies

The Natural Heritage Information Centre (NHIC) and the Illinois State Museum (under the direction of Drs Cashett and Mahoney) are currently working together to determine the genetic diversity of the Minesing Wetlands population of Hine's Emerald. Work is being conducted on both mitochondrial and nuclear DNA sequencing from populations across the United States and Ontario. When completed we should understand the

variation within the Ontario population compared with the entire Hine's Emerald geographic range (Mahoney pers comm. 2012). This work will play an integral part of guiding future conservation efforts for this population.

Further work has been conducted in the United States which used microsatellite markers of both adult and larval Hine's Emerald adults to examine relatedness between populations in Illinois and Wisconsin (Monroe et al. 2010). An exciting part of this study was using non-lethal methods to collect genetic material (including the use of excuvae, fecal pellets and wing-clippings). Using the 10 microsatellites markers from this study will aid in understanding the population across the entire Hine's Emerald range. This work will also contribute to a greater understanding of population structure that may aid in any attempts at re-establishment or augmentation for Hine's Emerald in the United States populations.

#### Habitat Requirements

Recent hydrogeological studies in Minesing Wetlands (Post 2009, Post et al. 2010, Spoelstra and Post 2012) have assisted in documenting hydrogeological conditions (groundwater levels and groundwater chemistry) in ecotone gradients from the east periphery of the wetland through the boreal swamps to the open fen habitats along two transects of shallow nested monitoring wells. The 2010 study provided a useful comparison between 1999 hydrogeological and ecological conditions (Bradford 1999) and current (Post 2009) conditions.

Intensive groundwater monitoring was conducted (Bradford 1999, Post et al. 2010) at twelve locations within the wetland. Collectively, these groundwater-focused studies provide important baseline information regarding hydrogeological conditions that provide critical support for Hine's Emerald habitat in Minesing Wetlands.

Anticipated future hydrogeochemical characterization in the wetland includes:

- establishing a series of monitoring wells up-gradient of the wetland for collecting water samples and monitoring water levels in the groundwater source;
- investigating the intra-annual variability of groundwater chemistry in the wetland and in nearby upland groundwater; and
- establishing a regular monitoring program of water levels and groundwater chemistry for the Minesing Wetlands for the purpose of detecting and quantifying long-term changes (Spoelstra and Post 2012).

#### Habitat Protection and Stewardship

The Nature Conservancy of Canada and the Nottawasaga Valley Conservation Authority's Minesing Wetlands Natural Area Conservation Plan (2011) identifies conservation actions within Hine's Emerald habitat. Actions include working with landowners to conserve areas identified as Hine's Emerald breeding habitat, conducting a landscape connectivity analysis and monitoring and removing invasive species.

## 2.0 RECOVERY

### 2.1 Recovery Goal

The recovery goal for Hine's Emerald is to prevent any loss of population, genetic diversity, or habitat functionality at extant sites or at any other extant locations which may be identified in the future in Ontario.

### 2.2 Protection and Recovery Objectives

Table 1. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Protect and maintain the quantity and quality of Hine's Emerald habitat and habitat functionality, including the hydrological and hydrogeological function
2	Reduce or mitigate threats to Hine's Emerald and its habitat
3	Increase knowledge of Hine's Emerald biology in Ontario including distribution, abundance, life history and habitat needs
4	Increase public awareness and understanding of Hine's Emerald and its habitat in Ontario

### 2.3 Approaches to Recovery

Table 2. Approaches to recovery of Hine's Emerald in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Objective 1: Protect and maintain the quantity and quality of Hine's Emerald habitat and habitat functionality, including the hydrological and hydrogeological function				
Critical	Ongoing	Habitat protection	<p><b>1.1</b> Work with municipalities and other planning agencies to protect habitat and populations through municipal land use planning processes</p> <ul style="list-style-type: none"> <li>• provide habitat mapping to municipalities and other planning agencies</li> <li>• work with municipalities to adopt protection measures in official plans, other planning documents and municipal plan review processes</li> <li>• work with municipalities to assist in wetland protection including protection of upland hydrogeological functions that support wetland habitats</li> <li>• work with municipalities in maintaining water budgets, particularly in recharge areas, to ensure there is no net loss in recharge. This includes maintaining current hydrologic and hydrogeologic function</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Contamination of groundwater</li> </ul>
Critical	Short-term	Habitat protection	<p><b>1.2</b> Develop a habitat regulation to provide enhanced protection and clarity on the area defined as habitat for Hine's Emerald in Ontario.</p>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Contamination of groundwater</li> </ul>
Necessary	Ongoing	Habitat protection	<p><b>1.3</b> Identify high-priority private lands within Hine's Emerald distribution and promote securement through conservation easement, stewardship agreement or land acquisition when there are willing sellers.</p> <ul style="list-style-type: none"> <li>• prioritize areas according to urgency of threat</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Contamination of groundwater</li> </ul>

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			<ul style="list-style-type: none"> <li>• identify and contact private landowners</li> <li>• Determine the ideal protection strategy for each site</li> </ul>	
Necessary	Ongoing	Habitat protection	<b>1.4</b> Identify areas of probable habitat for Hine's Emerald. <ul style="list-style-type: none"> <li>• through GIS modeling, develop a habitat suitability index model of predicted habitat in Ontario</li> <li>• identify current landowner, management and land-use policies for these areas</li> </ul>	<ul style="list-style-type: none"> <li>• Population size and range</li> </ul>
Beneficial	Ongoing	Stewardship	<b>1.5</b> Where feasible, restore altered hydrological and/or hydrogeological regimes. <ul style="list-style-type: none"> <li>• research into low impact development potential</li> <li>• explore potential retrofits to enhance recharge function</li> <li>• promote enhanced recharge opportunities as new technologies and/or development arise</li> <li>• protect or restore hydrological regime in the larvae habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Contamination of groundwater</li> </ul>
Beneficial	Long-term	Stewardship	<b>1.6</b> Explore and encourage land owner incentive programs for Hine's Emerald habitat protection and restoration (e.g., Conservation Land Tax Incentive Program)	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> </ul>
Objective 2: Reduce or mitigate threats to Hine's Emerald and its habitat				
Critical	Ongoing	Management	<b>2.1</b> Develop and implement management actions to maintain or increase known population <ul style="list-style-type: none"> <li>• identify and assess known threats at the current extant site and at any sites identified through future inventory efforts</li> <li>• work with owners/managers to develop site-specific management plans to address threats through stewardship (e.g. invasive species control, managed access, and similar activities)</li> <li>• develop a best management practices document for activities that may alter the ground water of areas occupied Hine's Emerald</li> <li>• monitor sites to assess the effects of management</li> </ul>	<ul style="list-style-type: none"> <li>• All threats</li> </ul>

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			<p>actions</p> <ul style="list-style-type: none"> <li>• adapt management in response to monitoring results</li> <li>• report on management actions and outcomes</li> </ul>	
Critical	Ongoing	Habitat protection	<p><b>2.2</b> Protect burrowing crayfish and their habitat within known and suspected Hine's Emerald locations in Ontario.</p> <ul style="list-style-type: none"> <li>• determine threats to burrowing crayfish and mitigate where possible.</li> <li>• protect the habitat of burrowing crayfish</li> <li>• determine and monitor population estimates</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> </ul>
Necessary	Ongoing	Habitat protection	<p><b>2.3</b> Ensure protection and recovery approaches are identified in management plans for all applicable levels of government (including federal, provincial, municipal and conservation authorities)</p> <ul style="list-style-type: none"> <li>• identify appropriate zoning designations and activities in management and resource stewardship plans</li> <li>• encourage and enable agencies to ensure they are considering Hine's Emerald and the ESA when issuing authorizations that may impact the species or its habitat (e.g., MOE review of Permit to Take Water applications)</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Invasive species,</li> </ul>
Necessary	Ongoing	Management	<p><b>2.4</b> Monitor and mitigate invasive species in and around Hine's Emerald habitat</p> <ul style="list-style-type: none"> <li>• identify invasive species in immediate habitat and adjacent areas.</li> <li>• mitigate invasive species using best available information such as the Ontario Phragmites Best Management document (OMNR 2011).</li> <li>• encourage private stewardship through programs such as the Ontario Invasive Plant Council and the Ontario Federation of Anglers and Hunters' aquatic invasive species program.</li> </ul>	<ul style="list-style-type: none"> <li>• Invasive species</li> </ul>
Objective 3: Increase knowledge of Hine's Emerald biology in Ontario including distribution, abundance, life history and habitat needs.				

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Critical	Ongoing	Inventory, Monitoring and Assessment	<p>3.1 Develop and implement a monitoring program to assess changes in populations and habitats over time</p> <ul style="list-style-type: none"> <li>• develop and/or adopt standardized monitoring protocols for the species at its different life stages and its habitat</li> <li>• complete monitoring at sites and intervals as prescribed by the protocols</li> <li>• collaborate with experts in the United States to develop and improve monitoring and sampling skills, techniques and data</li> <li>• report monitoring results at regular intervals and assess trends in populations, area of occupancy and habitat condition (threats) every five years</li> <li>• submit all data to the Ontario Odonata Atlas Database and Natural Heritage Information Centre (NHIC)</li> </ul>	<ul style="list-style-type: none"> <li>• All threats and knowledge gaps</li> </ul>
Critical	Ongoing	Inventory, Monitoring and Assessment	<p>3.2 Conduct surveys to locate new populations</p> <ul style="list-style-type: none"> <li>• create tools to identify Hine's Emerald larvae and adults from other dragonflies.</li> <li>• use current/updated knowledge of habitat to develop a GIS model of predicted habitat in Ontario, especially keying in on fen habitats and areas with Digger Crayfish burrows.</li> <li>• conduct field surveys in areas targeted by habitat type searches over a minimum of two field seasons to determine whether the species is present</li> <li>• conduct surveys in areas of similar habitat surrounding Minesing Wetland that may currently or historically harbour larval populations, including but not limited to Bear Creek, Marl Creek, Marl Lake, Matheson Creek and Willow Creek habitats</li> <li>• document any new occurrences of the species and the surrounding habitat, and submit all data (positive and negative) to the NHIC and the Ontario Odonata Atlas Database</li> <li>• use the findings or research on habitat requirements to refine the habitat model</li> </ul>	<ul style="list-style-type: none"> <li>• All threats</li> <li>• All knowledge gaps on habitat requirements</li> </ul>
Critical	Short-term	Research	<p>3.3 Investigate the sensitivity of Hine's Emerald to various</p>	<ul style="list-style-type: none"> <li>• Alteration of</li> </ul>

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			<p>factors that may influence habitat constraints (e.g., water quality/quantity)</p> <ul style="list-style-type: none"> <li>• conduct studies to determine microhabitat characteristics</li> <li>• coordinate research with experts both in Canada and the United States</li> <li>• coordinate research between agencies who are conducting research within in Hine's Emerald habitat</li> <li>• explore sensitivity to groundwater fluctuations</li> </ul>	<p>hydrology</p> <ul style="list-style-type: none"> <li>• Contamination of groundwater</li> <li>• Knowledge gaps</li> </ul>
Necessary	Short-term	Research	<p>3.4 Investigate the relationship between Hine's Emerald and crayfish species</p> <ul style="list-style-type: none"> <li>• document the distribution of crayfish whose burrows Hine's Emerald are known to use (i.e., Digger Crayfish and Devil Crawfish)</li> <li>• determine the relationship between Hine's Emerald and burrowing crayfish (i.e., Digger Crayfish and Devil Crawfish) in Ontario</li> <li>• determine if there is a relationship between Hine's Emerald and any other crayfish species in Ontario</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> <li>• Knowledge gaps</li> </ul>
Necessary	Ongoing	Research	<p>3.5 Investigate interspecies relationships</p> <ul style="list-style-type: none"> <li>• investigate interactions between other Emerald species</li> <li>• conduct genetic DNA studies with such collaborators as NHIC, conservation authorities, University of Waterloo, University of Guelph and <i>Somatochlora</i> DNA experts (e.g., Illinois State Museum)</li> <li>• collaborate with Illinois State Museum to receive copies of genetic analyses involving Hine's Emerald from Ontario</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge gaps</li> </ul>
Necessary	Ongoing	Monitoring	<p>3.6 Monitor hydrogeological function within Minesing Wetlands</p> <ul style="list-style-type: none"> <li>• monitor groundwater levels in recharge areas</li> <li>• monitor groundwater quality in recharge and in suitable habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of hydrology</li> </ul>

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			<ul style="list-style-type: none"> <li>• monitor surficial hydrological function in larval habitat</li> <li>• enhance the number of shallow monitoring wells along existing groundwater transects in suitable habitats</li> <li>• monitor groundwater levels along existing groundwater transects in suitable habitats</li> <li>• Calculate water budgets</li> </ul>	
Beneficial	Ongoing	Communication	3.7 Participate in inter-jurisdictional recovery and research teams, including the United States Fish and Wildlife Service Hine's Emerald recovery team	<ul style="list-style-type: none"> <li>• All threats</li> <li>• All knowledge gaps</li> </ul>
Objective 4: Increase public awareness and understanding of Hine's Emerald and its habitat in Ontario				
Necessary	Short-term	Communication	<b>4.1</b> Provide information to stakeholders and interested parties to increase their awareness of this species <ul style="list-style-type: none"> <li>• identify audiences with the most potential for conservation (e.g., landowners, municipal agencies, and other interest groups) and gauge their awareness and information needs</li> <li>• in coordination with OMNR, identify appropriate means of communicating with target audiences (e.g., workshops, newsletters, internet sites, public meetings)</li> <li>• develop and communicate tangible stewardship steps the stakeholder can undertake</li> <li>• create programming on the bigger picture of Hine's Emerald habitats and their importance to humans (i.e., the importance of Minesing Wetlands)</li> </ul>	<ul style="list-style-type: none"> <li>• All threats</li> </ul>

## 2.4 Area for Consideration in Developing a Habitat Regulation

*Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the authors will be one of many sources considered by the Minister when developing the habitat regulation for this species.*

It is recommended that the area regulated as habitat for Hine's Emerald include all extant locations. In Ontario, the extant sites currently include only the Minesing Wetlands and possibly some adjacent lands where adults have been observed in potential larval habitat. This recommendation is specific to Minesing Wetland, given our current knowledge of Hine's Emerald distribution in Ontario. If other extant locations are found in the future, additional habitat should be prescribed under the ESA on a site-specific basis. Furthermore, due to the lack of understanding of Hine's Emerald biology and knowledge of the Ontario population, serious knowledge gaps exist on the habitat for Hine's Emerald. Given this, it is recommended that the area prescribed as habitat for Hine's Emerald be re-evaluated as new information is gathered.

Minesing Wetlands and the surrounding area are found over limestone bedrock, with rich and deep, mineral soils. Groundwater discharge plays an essential role in the fen areas that relate to Hine's Emerald habitat. The principal source of groundwater to the fen areas correspond to the Snow Valley Upland area, east of the Minesing Wetlands (Bradford 1999, Beckers and Frind 2001, Post et al. 2010).

Hine's Emerald has two different life stages (larval and adult) that depend on different habitat. First, the larvae require areas that support their foraging, overwintering and refuge habitats. These areas are characterized as string fen and wet meadow areas. There is strong evidence of Hine's Emerald larvae being dependent on Digger Crayfish and Devil Crawfish burrows as refuges (Pintor and Soluk 2006). Second, the adults require areas that support breeding, foraging and roosting habitats. These habitat requirements differ between female and male adult Hine's Emerald during the breeding season (Foster and Soluk 2006). Males have been found to occupy string fens and wet intermediate meadow areas, whereas females were found to occupy dry meadow areas (Foster and Soluk 2006, COSEWIC 2011). Adjacent forest areas provide protected, shaded areas for perching and roosting by both females and males (USFWS 2001).

Dispersal patterns of Hine's Emerald in Minesing Wetlands have not been studied. However, experts suggest that corridors that connect prescribed habitat are essential to the recovery of Hine's Emerald, particularly to enable their movement and dispersal (C.G. Evans pers. obs).

In order to protect both the adult and larvae stages of Hine's Emerald, it is recommended that the area prescribed as habitat include all fen, wetland meadows,

and hydrologically connected fen and wet meadow habitat where Hine's Emerald have been observed (Foster and Soluk 2006). The groundwater area that feeds the fen must be considered in order to protect the current hydrological regime. It is thought that 500 meters surrounding this area be considered the minimum local recharge area (R. Post, pers. obs.). Thus, in addition to the hydrologically connected fen and wet meadow habitat, the prescribed habitat should also include 500 metres beyond each of these habitats. Additionally, for the purposes of perching, movement and roosting, all forests and dry meadows that are adjacent to the areas described above should also be prescribed as habitat.

Corridors are believed to be both natural (creeks, swales and other water features) and anthropogenic features (trails, utility rights-of-way and gravel roads) that have forested edges or riparian habitat (C.G. Evans and D. Featherstone, pers. obs.). To allow for migration and dispersal between habitat patches used by Hine's Emerald it is recommended that corridors connecting these areas be prescribed as habitat.

Due to the dependence of Hine's Emerald habitat on groundwater recharge it is recommended that prescribed habitat include the Snow Valley Uplands areas as defined by Becker and Frind (2001), where the current regional groundwater infiltration regime is maintained for the entire Minesing Wetlands (i.e., maintaining the current water balance and water quality).

### 3.0 GLOSSARY

Calcareous: A type of sediment, sedimentary rock, or soil type formed from, or contains a high proportion of calcium carbonate.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

- 1 = critically imperilled
- 2 = imperilled
- 3 = vulnerable
- 4 = apparently secure
- 5 = secure

Conspecific: From the same species

Discharge Area: An area in which there are upward components of hydraulic head in the aquifer. Ground water is flowing toward the surface in a discharge area and may escape as a spring, seep or baseflow or by evaporation and transpiration.

*Endangered Species Act, 2007* (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Exuviae: The cast-off skins or coverings. In this case, the cast off shell or covering of the dragonfly larvae, shed after the larva emerges from the water to molt to the adult life stage.

Fen: Wetlands with unique hydrology that provides mineralized water to the soil's surface.

Haplotype: The genetic makeup of an individual with respect to a specific pair of alleles or genes.

Hydrogeology: The study of the interrelationships of geologic materials and processes with water, especially ground water.

**Hydrology:** The study of the occurrence, distribution, and chemistry of all waters of the earth.

**Instar:** An insect or other arthropod between molts

**Larva (pl: larvae):** An immature stage of any invertebrate that differs from the adult stage.

**Metapopulation:** A population belonging to a group of populations of the same species that exchange individuals through migration and recolonize sites in which other metapopulations have become extinct.

**Molt:** Shed of old shell to make way for new growth

**Nymph:** A larva of an insect with incomplete metamorphosis

**Odonata:** The taxonomic order comprising dragonflies and damselflies.

**Oviposition:** To lay eggs, especially by means of an ovipositor.

**Ovipositor:** An organ found in some species of insects at the end of the female abdomen. This organ is used to deposit eggs.

**Recharge area:** An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area.

**Species at Risk Act (SARA):** The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk to which the SARA provisions apply. Schedules 2 and 3 contain lists of species that at the time the act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

**Species at Risk in Ontario (SARO) List:** The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

**Succession:** The progressive replacement of one dominant type of species or community by another in an ecosystem.

**Teneral:** The period when the adult insect is newly emerged from the pupal case or nymphal skin. During the teneral period, the insect's exoskeleton has not hardened or darkened, leaving it vulnerable.

Thoracic: Arising from the thorax, the portion of the body between the head and the abdomen.

Tibial (Tibia): The fourth segment of the insect leg, between the femur and tarsi.

Water balance: An equation that can be used to describe the flow of water in and out of a system.

Water budget: An evaluation of all the sources of supply and the corresponding discharges with respect to an aquifer or a drainage basin.

Water table: The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few feet into the zone of saturation and then measuring the water level in those wells.

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**Part 3 – *Hine’s Emerald* – Ontario Government Response  
Statement, prepared by the Ontario Ministry of  
Natural Resources, 2013**

*Natural. Valued. Protected.*

# Hine's Emerald

## Ontario Government Response Statement



Photo: C. G. Evans

### PROTECTING AND RECOVERING SPECIES AT RISK IN ONTARIO

Species at risk recovery is a key part of protecting Ontario's biodiversity. Biodiversity – the variety of living organisms on Earth – provides us with clean air and water, food, fibre, medicine and other resources that we need to survive.

The *Endangered Species Act, 2007* (ESA) is the Government of Ontario's legislative commitment to protecting and recovering species at risk and their habitats. As soon as a species is listed as extirpated, endangered or threatened under the ESA, it is automatically protected from harm or harassment. Also, immediately upon listing, the habitats of endangered and threatened species are protected from damage or destruction.

Under the ESA, the Ministry of Natural Resources (the Ministry) must ensure that a recovery strategy is prepared for each species that is listed as endangered or threatened. A recovery strategy provides science-based advice to government on what is required to achieve recovery of a species.

### GOVERNMENT RESPONSE STATEMENTS

Within nine months after a recovery strategy is prepared, the ESA requires the Ministry to publish a statement summarizing the government's intended actions and priorities in response to the recovery strategy. The recovery strategy for Hine's Emerald (*Somatochlora hineana*) was completed on January 11, 2013 ([http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/stdprod\\_099155.pdf](http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/stdprod_099155.pdf)).

The response statement is the government's policy response to the scientific advice provided in the recovery strategy. All recommendations provided in the recovery strategy were considered and this response statement identifies those that are considered to be appropriate and necessary for the protection and recovery of the species. In addition to the strategy, the response statement is based on input from stakeholders, other jurisdictions, Aboriginal communities and members of the public. It reflects the best available traditional, local and scientific knowledge at this time and may be adapted if new information becomes available. In implementing the actions in the response statement, the ESA allows the Ministry to determine what is feasible, taking into account social and economic factors.

Hine's Emerald is a dragonfly known for its brilliant emerald green eyes. It is relatively large, measuring 60-65 mm long with a 90-95 mm wingspan, and has a dark metallic green thorax with two creamy yellow stripes. The species occurs only in the Minesing Wetlands in Simcoe County.

## MOVING FORWARD TO PROTECT AND RECOVER HINE'S EMERALD

Hine's Emerald is listed as an endangered species under the ESA, which protects both the animal and its habitat. The ESA prohibits harm or harassment of the species and damage or destruction of their habitat without authorization. Such authorization would require that conditions established by the Ministry be met.

Hine's Emerald has a limited distribution in northeastern North America where it is listed as endangered or extirpated in each province or state in which it is found. In Canada, the single known population is in the Minesing Wetlands, between the towns of Barrie and Wasaga Beach in southern Ontario. Although 28 other sites have been identified as having potentially suitable habitat, extensive searches for additional populations in south-central Ontario have failed to find any. Negative survey results are not considered uncommon for this species because it is very difficult to locate and capture, due largely to the fact that its habitat is rare and often remote.

The species lives in calcareous wetlands including marshes and fens which are fed primarily by groundwater from intermittent seeps. Adjacent forest areas provide shaded areas for perching, and corridors between habitat patches are considered essential for movement and dispersal. The main threats to Hine's Emerald in Ontario are habitat loss due to changes in hydrology, competition from invasive species, and natural vegetation succession. Additionally, this species is dependent on the burrows created by crayfish to provide refuge from seasonal drought and freezing. Given that the only known occurrence of this species is within a wetland that is protected as a Provincially Significant Wetland (PSW) and as an Area of Natural and Scientific Interest (ANSI), the recovery of this species will be best achieved through the protection and management of its habitat, associated research, and mitigation of threats.

**The government's goal for the recovery of Hine's Emerald is to maintain the persistence of the species and its habitat where it currently exists in Ontario.**

Protecting and recovering species at risk is a shared responsibility. No single agency or organization has the knowledge, authority or financial resources to protect and recover all of Ontario's species at risk. Successful recovery requires inter-governmental co-operation and the involvement of many individuals, organizations and communities.

In developing the government response statement, the Ministry considered what actions are feasible for the government to lead directly and what actions are feasible for the government to support its conservation partners to undertake.

### GOVERNMENT-LED ACTIONS

To help protect and recover Hine's Emerald, the government will directly undertake the following actions:

- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.
- Encourage the submission of Hine's Emerald data to the Ministry's central repository at the Natural Heritage Information Centre.
- Undertake communications and outreach to increase public awareness of species at risk in Ontario.
- Protect Hine's Emerald and its habitat through the ESA. Develop and enforce the regulation identifying the specific habitat of the species.
- Support conservation, agency, municipal and industry partners, and Aboriginal communities and organizations to undertake activities to protect and recover Hine's Emerald. Support will be provided through funding, agreements, permits (including conditions) and advisory services.
- Establish and communicate annual priority actions for government support in order to encourage collaboration and reduce duplication of efforts.

### GOVERNMENT-SUPPORTED ACTIONS

The government endorses the following actions as being necessary for the protection and recovery of Hine's Emerald. Actions identified as "high" will be given priority consideration for funding or for authorizations under the ESA. The government will focus its support on these high-priority actions over the next five years.

<b>Focus Area:</b>	<b>Protection and Management</b>
<b>Objective:</b>	Maintain the quantity and quality of Hine's Emerald habitat and mitigate threats.
	<b>Actions:</b>
	<ol style="list-style-type: none"> <li>1. <b>(HIGH)</b> Develop and distribute best management practices (BMPs) to promote the protection of wetlands and upland groundwater infiltration associated with the Minesing Wetlands in order to maintain the current water balance and water quality. BMPs may include: <ul style="list-style-type: none"> <li>■ using low impact development approaches that maintain the current quantity of groundwater flowing from recharge areas in adjacent uplands into the Minesing Wetlands;</li> <li>■ minimizing the amount of contaminant run-off due to road salt, pesticides, fertilizers, etc., into the Snow Valley Uplands, which runs into the underlying aquifer that feeds the Minesing Wetlands; and</li> <li>■ improving faulty septic systems.</li> </ul> </li> </ol>

2. Maintain suitable habitat function by controlling invasive plant species within Hine's Emerald habitat and implementing MNR protocols for the control of European Common Reed (*Phragmites australis* ssp. *australis*).

**Focus Area:** Research and Monitoring

**Objective:** Increase knowledge of Hine's Emerald biology in Ontario including distribution, abundance, life history, and habitat needs.

**Actions:**

3. **(HIGH)** Develop and implement a standardized monitoring program to assess changes in populations and habitat over time, including:
  - monitoring groundwater quantity and quality in recharge areas and larval habitat; and,
  - monitoring burrowing crayfish population levels and threats without disturbing the crayfish burrows (i.e. no pumping or digging of burrows).
4. Conduct surveys of suitable habitat surrounding Minesing Wetland to determine if there are any additional populations.

**IMPLEMENTING ACTIONS**

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Fund, Species at Risk Research Fund for Ontario, and the Species at Risk Farm Incentive Program. Conservation partners are encouraged to discuss project proposals related to the actions in this response statement with the Ministry. The Ministry can also advise if any authorizations under the ESA or other legislation may be required to undertake the project.

Implementation of the actions may be subject to changing priorities across the multitude of species at risk, available resources and the capacity of partners to undertake recovery activities. Where appropriate, the implementation of actions for multiple species will be co-ordinated across government response statements.

**REVIEWING PROGRESS**

The ESA requires the Ministry to conduct a review of progress towards protecting and recovering a species not later than five years from the publication of this response statement. The review will help identify if adjustments are needed to achieve the protection and recovery of Hine's Emerald.

## ACKNOWLEDGEMENT

We would like to thank all those who participated in the development of the "Recovery Strategy for the Hine's Emerald (*Somatochlora hineana*) in Ontario." for their dedication to protecting and recovering species at risk.

### **For additional information:**

Visit the species at risk website at [ontario.ca/speciesatrisk](http://ontario.ca/speciesatrisk)

Contact your MNR district office

Contact the Natural Resources Information Centre

1-800-667-1940

TTY 1-866-686-6072

[mnr.nric.mnr@ontario.ca](mailto:mnr.nric.mnr@ontario.ca)

[ontario.ca/mnr](http://ontario.ca/mnr)