KINROSS Great Bear

# Great Bear Gold Project Impact Statement

## Section 9: Analysis of Changes to Migratory Birds

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# Acronyms and Abbreviations

| | |
|---|---|
| ANA | Asubpeeschoseewagong Netum Anishinabek |
| ARU | Autonomous recording unit |
| BAM | Boreal avian modelling |
| CBD | Convention on Biological Diversity |
| CBS | Canadian Biodiversity Strategy |
| COSEWIC | Committee on the Status of Endangered Wildlife in Canada |
| ECCC | Environment and Climate Change Canada |
| FMU | Forest management unit |
| FRI | Forest resource inventory |
| fVC | Federal valued component (valued component under federal jurisdiction) |
| GIS | Geographic information system |
| GLM | Generalized linear model |
| HSM | Habitat suitability models |
| KMGBF | Kunming-Montreal Global Biodiversity Framework |
| LSA | Local Study Area |
| LSFN | Lac Seul First Nation |
| MBCA | *Migratory Birds Convention Act* |
| NWOMC | Northwestern Ontario Métis Community |
| PA | Project Area |
| $PM_{10}$ | Particulate matter less than 10 micrometres in diameter |
| $PM_{2.5}$ | Particulate matter less than 2.5 micrometres in diameter |
| Project | Great Bear Project |
| pVC | Pathway valued component |
| RSA | Regional Study Area |
| SAR | Species at risk |
| SARA | *Species at Risk Act* |
| TISG | Tailored Impact Statement Guidelines |
| TMF | Tailings management facility |
| VMF | Viggo management facility |
| WFN | Wabauskang First Nation |
| ZOI | Zone of influence |

# 9.0 Analysis of Changes to Migratory Birds

Migratory birds are considered a federal valued component (fVC) for the Great Bear Project (Project) as they are protected federally under the *Migratory Birds Convention Act* (MBCA). Migratory Birds considers species listed under Article I of the MBCA and migratory birds listed under Schedule 1 of the *Species at Risk Act* (SARA). Birds under federal jurisdiction are included in this fVC. Additionally, the Tailored Impact Statement Guidelines (TISG) indicate that migratory birds were raised as important to consider in the assessment based on comments received by the Impact Assessment Agency of Canada from participants during the Planning Phase of the Impact Assessment.

Field survey methods are described in the Terrestrial Baseline Environment Report (Appendix M-1). Modelling and mapping methods and results are described in the Terrestrial Technical Methods and Results report (Appendix M-2). While all data collected during baseline surveys and additional modelling and mapping were completed at the species level, migratory birds were sorted into groupings based on the rationale provided in the TISG. Groupings defined for this fVC are forest birds, shorebirds, waterfowl, waterbirds, marsh birds, edge / open / early successional birds, SARA Schedule 1 birds, and birds with residence descriptions. For forest birds, shorebirds, waterfowl, waterbirds, marsh birds, and edge / open / early successional birds, proxy species were chosen based on the presence of birds at point counts and the availability of habitat and / or density models (see Appendix M-2 for details). The results for these proxy species are considered applicable to other migratory bird species within the grouping. SARA Schedule 1 birds and birds with residence descriptions are assessed under the criteria migratory SAR birds (Section 9.7.5 and Section 9.8.5). Data were screened to determine which migratory Species at Risk (SAR) birds were likely to be found in the Regional Study Area (RSA; Appendix M-2).

## 9.1 Pathway Linkages to other Valued Components

### 9.1.1 Pathway Linkages to Migratory Birds

Migratory birds may be affected directly, indirectly or incidentally by select pathway valued components (pVCs) or other fVCs. Direct pathways to effects on migratory birds may occur from changes in vegetation communities (Section 7.8). Indirect pathways to effects on migratory birds may occur from changes in air quality (Section 7.2), sound (Section 7.3), vibration (Section 7.4), groundwater (Section 7.5), surface water flows and levels (Section 7.6), water quality (Section 7.7) and fish (Section 8). Some migratory birds consume fish and, as such, may interact with fish populations within the Local Study Area (LSA). Changes to fish habitat, fish communities and fish health and mortality may interact with food availability and quality to migratory birds, depending on their reliance on fish as a food source at a localized scale. Changes to fish are assessed in Section 8.

### 9.1.2 Pathway Linkages from Migratory Birds to fVCs

Migratory birds will interact with Indigenous Peoples through traditional land and resource use (Sections 10.6, 11.6, 12.6, 13.6 and 14.6), and health (Sections 10.9, 11.9, 12.9, 13.9 and 14.9) as some migratory birds are a traditional food for Indigenous people.

## 9.2 Assessment Approach

The approach to the assessment of potential effects on migratory birds includes:

- Description of the relevant regulatory and policy setting (Section 9.2.1)
- Description of the spatial and temporal boundaries used for migratory birds (Section 9.2.2)
- Identification of criteria and indicators along with the associated rationale (Section 9.2.3)
- An outline of the analytical methodology conducted for the assessment and the key assumptions and use of the conservative approach (Section 9.2.4 and Section 9.2.5)
- Description of the approach to determining significance for migratory birds (Section 9.2.6)
- Influence of consultation and engagement (Section 9.3).

The assessment of potential effects to migratory birds is supported by a description of the existing conditions (Section 9.4), the identification and description of applicable pathways of potential effects to migratory birds (Section 9.5), and a description of mitigation measures (Section 9.6). With the application of mitigation measures to the potential effects on migratory birds, the residual effects are then characterized in Section 9.7.

### 9.2.1 Regulatory Setting

The Project is located in Ontario and will need to meet applicable federal and provincial legislation and regulatory requirements. Provincial and federal regulatory agencies have prescribed criteria, benchmarks and standards. Government policies, objectives, standards or guidelines most relevant to birds are summarized below. Further information regarding anticipated approval requirements is provided in Section 19.

#### 9.2.1.1 Federal

Canada’s federal obligations under the Convention on Biological Diversity (CBD) commit the Government of Canada to conserving biological diversity, ensuring the sustainable use of biological resources, and promoting the fair and equitable sharing of benefits arising from the use of resources, consistent with the principles of sustainable development set out in Agenda 21, adopted at the 1992 United Nations Conference on Environment and Development (CBD 2006a). Agenda 21 is a global, non-binding action plan that provides practical guidance for integrating environmental protection, social considerations and economic development in decision-making, and the CBD was conceived as an instrument to translate the Agenda 21 biodiversity-related principles into action (CBD 2006a; UNCED 1992). In fulfilling its CBD obligations, Canada must develop and implement a national biodiversity strategy, integrate biodiversity considerations into policies, plans and project-level decisions, identify and monitor components of biodiversity affected by human activities, establish and manage protected and conserved areas, and apply environmental impact assessment processes for projects likely to cause significant adverse effects on biological diversity.

These obligations also require minimizing and mitigating biodiversity impacts, supporting ecosystem restoration and species recovery, respecting and incorporating Indigenous knowledge and practices relevant to conservation and sustainable use, and reporting on progress toward national and global biodiversity targets, including those under the Kunming–

Montreal Global Biodiversity Framework (KMGBF; CBD 2006a,b; UNCED 1992; UN Documents Cooperation Circles 2026).

Canada has developed several interrelated frameworks to fulfill its obligation under the CBD, including the Canadian Biodiversity Strategy (CBS), which was the original response to the CBD. The CBS reaffirms that governments (provincial, territorial and federal) must create the policy and research conditions to lead the conservation of biodiversity and the sustainable use of biological resources. The governments will work in cooperation with stakeholders and members of the public to implement the strategic directions contained in the CBS, in accordance with their policies, plans, priorities and fiscal capabilities (Biodivcanada 1995).

The KMGBF supports the achievement of the Sustainable Development Goals, builds on the Convention's previous strategic plans, and sets out an ambitious pathway to realize the global vision of a world living in harmony with nature by 2050. Among the Framework's key elements are four goals for 2050 and 23 targets for 2030 (CBD 2006c). Federal Impact Assessment and decision-making increasingly consider whether projects may support or hinder progress toward key targets, particularly those related to habitat loss, ecosystem restoration, protected areas, species recovery, pollution reduction, Indigenous participation and biodiversity mainstreaming (CBD 2006c; FAO 2026).

Additional ways the federal government may support the CBD, CBS, KMGBF and supporting frameworks are through the *Canada Wildlife Act* and Bird Conservation Regions. The *Canada Wildlife Act* provides the legal authority for the Government of Canada to conduct wildlife research, conserve wildlife populations and habitats, and designate and manage National Wildlife Areas on federal lands and waters (Government of Canada 2026). The Bird Conservation Regions are ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues (Government of Canada 2018). Appendix M1 and Section 9 identify that the Project falls within Bird Conservation Region 8.

Specific to this Project, federal legislation that supports the implementation of Canada's biodiversity commitments includes the SARA along with associated recovery strategies and action plans, and the MBCA and the associated Migratory Birds Regulations 2022. Recovery strategies under the SARA, are only required for species listed as extirpated, endangered or threatened on Schedule 1. Special Concern species do not require recovery strategies; instead, management plans are prepared for these species. Little Brown Myotis, Northern Myotis and Boreal Caribou are listed as endangered or threatened species and are discussed along with their recovery strategies, in Section 7.12.

Barn Swallow, Bank Swallow, Canada Warbler and Eastern Whip-poor-will are the only federally listed endangered or threatened bird species confirmed for the Project. All four species are also protected under the MBCA. Barn Swallow does not have a recovery strategy, and the critical habitat description published in the federal recovery strategy for Bank Swallow is currently insufficient to fully identify habitat necessary for the species' recovery (ECCC 2022a); however, both species have residence descriptions, which are considered in this Impact Statement. The recovery strategy for Canada Warbler does not identify the habitat necessary for its survival or recovery (EC 2016b), and Eastern Whip-poor-will's recovery strategy only partially identifies critical habitat (ECCC 2018). Critical habitat for Eastern Whip-poor-will corresponds to the areas of suitable nesting and / or foraging habitats with confirmed breeding or multiple occupancy since 2001. Although recovery strategies and critical habitat identification are incomplete for these species, these documents represent the best available information on species ecology, habitat associations, occupancy patterns and sensitivity to disturbance, and therefore remain relevant and have been used to inform Project-level effects assessment and mitigation under the SARA and the MBCA in the Impact Statement. The Project does not occur within any known or identified critical habitat for the federally listed bird species considered in this assessment.

Section 7.12 and Section 9.7.5 discuss the potential effects, if any, of the Project on SAR and their habitats, and including for special concern species.

##### 9.2.1.1.1 Migratory Birds Convention Act

The MBCA was passed in 1917 and updated in 1994 and 2005 to implement the Migratory Birds Convention. Article I of the Convention define migratory birds. Listed species are native or naturally occurring and are known to occur regularly in Canada. In general, birds not falling under federal jurisdiction within Canada include grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays, kingfishers, and some species of blackbirds (Government of Canada 2017). Most birds found in the Project Area (PA) receive protection under the MBCA, and nearly all the remaining species receive similar protection under the provincial *Fish and Wildlife Conservation Act*. Birds not included under migratory birds are considered a pVC, and described in Section 7.11 (other wildlife) or Section 7.12 (SAR).

The MBCA is administered by Environment and Climate Change Canada (ECCC) and prohibits harming and / or killing most species of birds and / or destroying or collecting their eggs or nests. The incidental take of migratory birds and the disturbance, destruction, or taking of the nest of a migratory bird is prohibited. The MBCA, together with the Migratory Birds Regulations, provides protection to migratory bird nests during the period considered to have a high conservation value (i.e., generally during the nesting period). ECCC and the Canadian Wildlife Service have compiled nesting calendars that show the variation in nesting intensity by habitat type and nesting zone within broad geographical areas distributed across Canada, which can greatly reduce the risk of encountering a nest. Some species whose nests are reused or used by others continue to have year-round nest protection unless they are abandoned (e.g., Pileated Woodpecker and herons).

##### 9.2.1.1.2 Species at Risk Act

The SARA was passed into law in 2002 and was last amended on November 27, 2024. The SARA aims to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species and to manage species to prevent further risk to their status. The SARA provides legal protection to SAR listed in Schedule 1 if they have a designation of Extirpated, Endangered, or Threatened with respect to harming the species or its residence. Species with Extirpated, Endangered, or Threatened federal designations require recovery strategies or conservation action plans that identify their critical habitat for mandatory protection from damage or destruction. Species listed as Special Concern in Schedule 1 are not legally protected under the SARA but require a management plan.

The SARA applies to federal lands and outside of federal lands to migratory birds (i.e., those species listed under Article I of the MBCA that also fall under Schedule 1 of the SARA). This does not include the species' critical habitat, but it does include the residences of migratory birds that have residence descriptions.

As the Project is subject to a federal Impact Assessment, and under section 79(2) of the SARA, the effects of the Project on the federally listed wildlife species and their critical habitats must be identified. If the Project is carried out, measures must be taken to avoid or lessen negative effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plan. ECCC must be notified of impacts to the listed species or their critical habitat.

#### 9.2.1.2 Provincial Legislation, Policies and Guidelines

Species considered in this section may also be covered under provincial Acts such as the *Fish and Wildlife Conservation Act* and the *Endangered Species Act*.

##### 9.2.1.2.1 Endangered Species Act

The *Endangered Species Act* is administered by the Ministry of the Environment, Conservation and Parks and includes provisions for the protection of provincially listed SAR. On June 5, 2025, the Province of Ontario passed Bill 5: Protecting Ontario by *Unleashing our Economy Act*, which included amendments to the *Endangered Species Act* that are now in force, as well as the creation of the *Species Conservation Act*, which is not yet in effect. Bird species solely under provincial jurisdiction are included in Section 7.11 and Section 7.12.

##### 9.2.1.2.2 Fish and Wildlife Conservation Act

The *Fish and Wildlife Conservation Act* is administered by the Ministry of Natural Resources (MNR), and applies to migratory birds, as they meet the definition of "*an animal that belongs to a species that is wild by nature and includes game wildlife and specially protected wildlife*".

Schedules 6 to 11 under the *Fish and Wildlife Conservation Act*, O. Reg. 669/98: Wildlife Schedules identify specially protected wildlife and are protected from being killed, trapped, or hunted. If wildlife requires collection or relocation at any point in the Project (i.e., through trapping / collection and relocation), a permit or approval under the Act may be required. Additionally, under Part II, Section 7(1), Nests and eggs, "*A person shall not destroy, take or possess the nest or eggs of a bird that belongs to a species that is wild by nature*." If the nest or eggs of species listed under the schedules for game birds, specially protected raptors, or specially protected birds, authorization for removal is required.

### 9.2.2 Spatial and Temporal Boundaries

The spatial boundaries used for the assessment of the potential effects on migratory birds are defined as follows:

- PA: includes the Project footprint, including all temporary and permanent areas associated with the mine site development, as well as an outside buffer of approximately 250 m, in order to allow for flexibility for design optimizations prior to construction and over the mine life (Figure 6.4-1). The size of the PA is 3,349 ha.
- LSA: is defined as the area beyond the Project footprint where Project direct and indirect effects may extend. The LSA is a 10 km buffer on the PA (Figure 9.2-1) and is based on the relevant ecological processes such as dispersion and movement between territories (Betts et al. 2007). The total size of the LSA is 69,230 ha.
- RSA: encompasses the PA and LSA and where appropriate, extends further to support a regional context in the assessment of potential Project effects. It is the maximum geographical extent or zone of influence (ZOI) in which potential effects from the Project are assessed. The RSA is developed to consider watersheds, eco-districts, Bird Conservation Region 8, and geology (Figure 9.2-1). The size of the RSA is 253,195 ha.

Potential effects were assessed for each Project phase (i.e., construction, operations and closure). The temporal boundaries for the assessment, as defined in Section 6.5, are:

- Construction phase:
  - Years -3 to -1 representing the primary period of Project construction
- Operations phase:
  - Years 1 to 26, during year 1 the Project will transition from construction into operations and will not be at full capacity
- Closure phase:
  - Years 27 to 29 represent the active closure period when the majority of the decommissioning and reclamation of the PA is completed
  - Year 30 is a passive closure period while the site is on care and maintenance as filling of the mine workings with water is completed, and excess water is treated
  - Year 31 is the final close out period when water treatment infrastructure is removed and site waters are acceptable for passive release to the environment.

### 9.2.3 Assessment Criteria

In undertaking the assessment of effects on migratory birds, changes to the following criteria were used:

- Abundance of habitat
- Connectivity and quality of habitat
- Density and populations
- Risk of mortality
- Migratory bird SAR.

The specific criteria, measurable indicators and the rationale for the selection of criteria are described in Table 9.2-1.

### 9.2.4 Analytical Methods

The potential impacts of the Project on migratory birds were assessed as either direct, indirect, or induced effects. Direct effects are those that result from the immediate and physical impact of Project activities on birds or their habitats. These effects occur at the point of activity and are typically observable and measurable in space and time (e.g. habitat loss due to land clearing). Indirect effects are those that arise as a consequence of Project activities but occur through pathways involving changes to environmental conditions, ecological processes, or species behaviour. Indirect effects may occur at a distance from the Project or over a longer time frame (e.g., noise-induced displacement). Induced effects are those that occur as a result of mitigation for another valued component (e.g., terrestrial habitat loss due to fish habitat compensation).

A comprehensive description of the methodology utilized in this section is provided in Appendix M-2. The identified direct and indirect effects were overlaid on the habitat and density maps developed from the environmental baseline conditions detailed in Appendix M-1 to quantify the impacts. The risk of mortality criteria is not an analytical analysis but an integrative one.

Migratory bird SAR followed the same analyses described above. Overall, a combination of these quantitative assessments, along with qualitative assessments based on expert knowledge and literature, was used to determine the significance of any impact on migratory birds.

Habitat suitability models (HSMs) were used to quantify habitat and to predict changes resulting from habitat alteration (Marzluff et al. 2002). Only moderate to high suitability habitat was considered in assessments. Two types of HSMs were used for the fVC Migratory Birds: the Boreal Avian Modelling Project Species-Specific Habitat Suitability Maps for Boreal-Breeding Passerine Species (BAM; Boreal Avian Modelling Project 2020); and forest resources inventory (FRI)-based habitat mapping (FRI-based model). Appendix M-2 describes methodological details for both of these models. The BAM was used for Yellow-Rumped Warbler, Black-and-White Warbler, Winter Wren, and Mourning Warbler. FRI-based models were used for Eastern Whip-poor-will and Common Nighthawk, Canada Warbler, Eastern Wood-pewee, Evening Grosbeak, Olive-sided Flycatcher, Yellow Rail, Wilson's Snipe, Mallard and Common Loon.

The density of migratory birds was modelled using general linear mixed-effect models (GLM). An offset to account for imperfect detection was included in the models (Solymos et al. 2013), as described in Appendix M-2. When data were insufficient for developing a density model in this manner, BAM densities were used.

#### 9.2.4.1 Direct Effects

To quantify the direct effects of removing habitat from the PA, it was conservatively assumed that all habitat (terrestrial and wetland vegetation communities) would be removed during the construction phase. The PA was overlaid on habitat suitability and species density maps, and the removal area was calculated (i.e., abundance of habitat and density and populations). For density maps, the area was converted to the number of birds and the percentage of the population impacted. Full methods for deriving density estimates and creating habitat suitability maps are in Appendix M-2. The assessment of these indirect effects used the predicted zones of influence with the HSMs to determine the predicted indirect effects.

For habitat maps, the connectivity of habitat impacts of the Project was assessed by calculating the difference in abundance and fragmentation before and after impact. Habitat changes at both the LSA and RSA scales were assessed. For assessing fragmentation splitting index is primarily reported (Jaegar 2000). Direct effects on habitat abundance and changes in fragmentation were assessed using simulations (Appendix M-2).

#### 9.2.4.2 Indirect Effects

A conservative approach was taken in the assessment of potential indirect effects to migratory birds. To determine the potential impact of worst case predicted indirect effects beyond the removal of the PA (direct effects), the assessment of indirect effects was quantified by overlaying the predicted ZOI of pVCs (Figure 9.2-2) with predictive habitat and density mapping. Potential effects on habitat quality were considered to occur from decreases in air quality, worst case groundwater dewatering, increased noise disturbance, increased ambient light, and changes in water quality.

These potential indirect effects on habitat quality were evaluated as follows:

- Cumulative air quality concentrations for the construction and operations phases were modelled for suspended particulate matter, which primarily consists of fugitive dusts generated from various activities such as crushing, screening, and material handling

(Section 7.2). Suspended particulate matter includes smaller particle size fractions, $PM_{10}$ and $PM_{2.5}$. The ZOI used for air quality (dust control) assumes no road dust control over a 24-hour averaging period (worst case scenario). Additionally, the ZOI utilizes 50% of the Ambient Air Quality Criteria contour line, which represents 60 $\mu g/m^3$. The ZOI was based on the worst case concentration contour for the construction phase and operations phase. An assessment of the closure and decommissioning phase ZOI of air quality was not completed as it would be considerably less than either the construction phase or operations phase.

- The worst case groundwater dewatering ZOI model simulates the potential complete dewatering of open pits and underground mine and does not represent any actual phase of the Project (Section 7.5). Since there is no separation of construction and operations stages, groundwater dewatering is presented in the operations phase only. The ZOI for groundwater is conservative, as it assumes long-term, simultaneous full dewatering of open pits and underground areas, a condition unlikely to occur during mine operations. No ZOI is present during the closure phase, as the mine workings will be filling with water and the ZOI will be rebounding. Groundwater levels are expected to recover once final closure is reached.
- The greatest noise emissions from the Project are expected to originate from equipment and infrastructure. The periods assessed were both daytime and evening / nighttime as per provincial and federal guidelines. For a conservative assessment, all equipment was modelled to operate simultaneously to evaluate the worst case scenario (Section 7.3). For each phase (construction, operation, closure), only daytime scenarios are used in this effects assessment as they represent a greater ZOI. The noise contour used to define the ZOI is based on a 40 dBA threshold, which aligns with typical ambient noise criteria for rural and sensitive receptor environments (i.e., natural sound sources). Additionally, effects on terrestrial wildlife have also been shown to begin at approximately 40 dBA (Shannon et al. 2016).
- Ground vibration and air overpressure were modelled and compared with guideline limits for blasting water overpressure and ground-borne vibration in proximity to Canadian Fisheries Waters (Section 7.4). These limits are applicable at the land - water interface. Vibration ZOI during operation and construction are wholly within the PA, and therefore, habitat disturbance for migratory birds is already captured and vibration is not considered further in the assessment of potential indirect effects.
- Potential indirect effects from changes to ambient light is provided in Appendix G. The assessment considered that the operations phase is a reasonable surrogate for construction phase lighting, and that ambient light conditions would no longer be influenced during the closure phase.
- Changes in surface water quality may affect habitat use. If present, elevated concentrations of metals, nutrients or cyanide, resulting from treated effluent discharge or seepage, could degrade water quality and indirectly affect migratory birds by reducing the availability of palatable aquatic forage. As discussed in Appendix K-1, some baseline concentrations (e.g., arsenic and phosphorus) in the receiving environment are greater than water quality guidelines for the protection of aquatic life in existing conditions. Water quality was modelled for all Project phases (Section 7.7). During construction, operations and active closure, treated effluent is discharged to the Chukuni River. Advanced water treatment processes, including membrane filtration, are used to remove

metals, sulphate and other parameters of concern prior to discharge to the environment. Water management, treatment, and discharge strategies will be designed to meet provincial and federal regulatory requirements.

### 9.2.5 Assumptions and the Use of the Conservative Approach

A conservative approach was used to support the assessment of potential effects on migratory birds, including the following assumptions:

- The PA considers the maximum footprint of the mine site for the evaluation of migratory bird effects as well as an outside buffer to allow flexibility for design optimizations prior to construction and over the mine life. The buffer includes approximately 250 m around the mine site area that may not be developed.
- It has been conservatively assumed that all migratory bird habitats within the PA will be removed during the construction phase. Where appropriate, vegetation communities will be maintained, such as to provide a buffer along waterbodies and mine site infrastructure. Therefore, the amount of habitat removed as a result of the PA is overestimated.
- Since the habitat within the PA is assumed to be lost or altered, it is excluded from the calculation of additional indirect effects (i.e., the PA is excluded from the indirect effects overlay).
- The FRI mapping serves as the foundation for some analyses. It is assumed that the FRI data and field-verified vegetation community data (Appendix M-1) are sufficiently accurate to support these analyses. It is assumed that the conditions depicted in the FRI data remain unchanged throughout the analysis period.
- BAM density and habitat mapping are used in some analyses. It is assumed that these models accurately reflect the study area at the time of analysis.
- Impacts are assessed using R (sf package), QGIS, or ArcGIS. Spatial calculations and coordinate reference systems introduce slight errors, and different assessment methods may yield slightly different results. It is assumed that these errors and differences are not ecologically meaningful at the scale of effects assessment.
- Progressive rehabilitation will occur at select locations prior to closure, when disturbance activities have been completed. The changes from progressive rehabilitation during construction and operation have not been included in habitat evaluations. It has been assumed that all rehabilitation activities will be completed during the closure phase.
- The ZOIs derived for pVCs incorporate inherent worst case scenario assumptions. These conservative assumptions have been carried forward in the assessment of indirect effects to maintain a precautionary approach.
- The noise threshold to evaluate the effects of sensory disturbance is assumed to be greatest within the 40 dBA contour area around the PA, as modelled in the noise modelling report (Appendix E-2). Literature indicates that wildlife responses begin at noise levels of approximately 40 dBA, with documented impacts occurring at levels below 50 dBA (Shannon et al., 2016). As a result, a 40 dBA continuous noise threshold, which corresponds to the noise level of a suburban area at night, is used as a

benchmark for disturbance. The indirect effects of noise are likely overestimated, as noise from the Project will not always be continuous.

- For calculating potential fragmentation, the total amount of habitat before the removal of the PA is used in all calculations (Appendix M-2). This ensures that the amount of landscape fragmentation is not underestimated.
- Implementation of sensitive timing windows has been assumed to effectively reduce the risk of mortality associated with vegetation removal during the construction phase. The development of new roads in previously undisturbed areas is assumed to increase mortality risk due to a lack of established avoidance behaviour by wildlife. Increased vehicular traffic associated with the Project is assumed to elevate the risk of wildlife-vehicle collisions.
- It is assumed that all mitigations will be effectively implemented, and that the conditions under which these mitigations have been recommended or tested by regulators or researchers remain true across time and context.

Overall, these assumptions provide a conservative approach to the effects assessment, and the predicted effects on migratory birds and their habitats are expected to be less.

### 9.2.6 Approach to the Determination of Significance

The residual effects for migratory birds are characterized in terms of the following attributes:

- Magnitude
- Geographic extent
- Duration
- Frequency
- Reversibility
- Timing.

These attributes along with the rankings are further described in Table 9.2.2.

In addition, the residual effects for migratory birds are characterized according to the ecological and / or social context within which the fVC is found. This is a qualitative measure of the sensitivity and / or resilience of the fVC to potential change. The following ranking is applicable:

- Level I: The fVC may or may not be sensitive but is capable of supporting the predicted change with typical mitigation measures.
- Level II: The fVC is sensitive and requires special measures to support the predicted change.
- Level III: The fVC is sensitive and unable to support the predicted change even with special measures.

As noted in Section 6.6, a residual effect is defined as significant if both of the following criteria are satisfied:

- A Level II or III rating is attained for all of the attributes involving magnitude, extent, duration, frequency and reversibility; and

- A Level II or III rating is attained for ecological and / or social context.

Conversely, if a Level I rating is achieved for any of the attributes involving magnitude, extent, duration, frequency or reversibility; or if a Level I rating is achieved for the ecological and / or social context, then the residual effect is considered to be not significant. In the event there is a significant adverse effect, the likelihood of occurrence is further described.

**Table 9.2-1: Criteria and Indicators for Migratory Birds**

| Criteria | Indicator | Rationale |
|---|---|---|
| Changes to Abundance of Habitat | • Percent change in the abundance of habitat in hectares<br>• Change in form and function of Confirmed Significant Wildlife Habitat (Appendix M-2): Waterfowl Stopover and Staging Areas: Aquatic, Waterfowl Nesting Area, Colonially Nesting Bird Breeding Habitat: tree / shrub, and Marsh Bird Breeding Habitat | • The area and relative abundance of habitat influences the availability of resources (e.g., food, shelter). As migratory birds rely on these resources, changes in habitat abundance may affect bird populations (Andrén et al. 1997; Betts et al. 2007; Le Brun et al. 2016). The abundance of Significant Wildlife Habitat is included in assessing this criterion. |
| Changes to Connectivity and Quality of Habitat | • Change in fragmentation before and after development; using splitting index to assess changes in fragmentation (Jaeger 2000; Appendix M-2) | • Connectivity and quality of habitat can affect movement and dispersal, as well as access to resources. Landscape fragmentation may reduce the ability of some wildlife species to persist, or even survive, on the landscape (St-Laurent et al. 2009). |
| Changes to Density and Populations | • Percentage of the population impacted under the worst case impact scenario.<br>• Potential increase in density in the RSA and LSA | • Low population densities can decrease social opportunities. At low population densities, the growth rate can increase; however, if a population density falls too low, birds may have trouble finding mates (Stephens and Sutherland 1999). At low population densities birds may suffer from reduced genetic diversity and lost social benefits such as predator warnings and resource availability cues (Courchamp et al. 1999). |
| Changes to Risk of Mortality | • Qualitative risk of mortality assessment<br>• Vegetation removal timing windows in relation to sensitive periods | • Elements of Project development, such as ground disturbance and vegetation clearing, may increase the risk of mortality for birds. Although boreal migratory bird species can persist despite mortality pressures (due to population buffering processes; Milles et al. 2023), added mortality risks may strain populations and decrease abundance. |
| Migratory Bird SAR | • The same criteria and indicators were assessed for SAR on Schedule 1 of SARA and also on Article 1 of the | • A subset of migratory bird species have been assessed as needing extra protections due to unstable or |

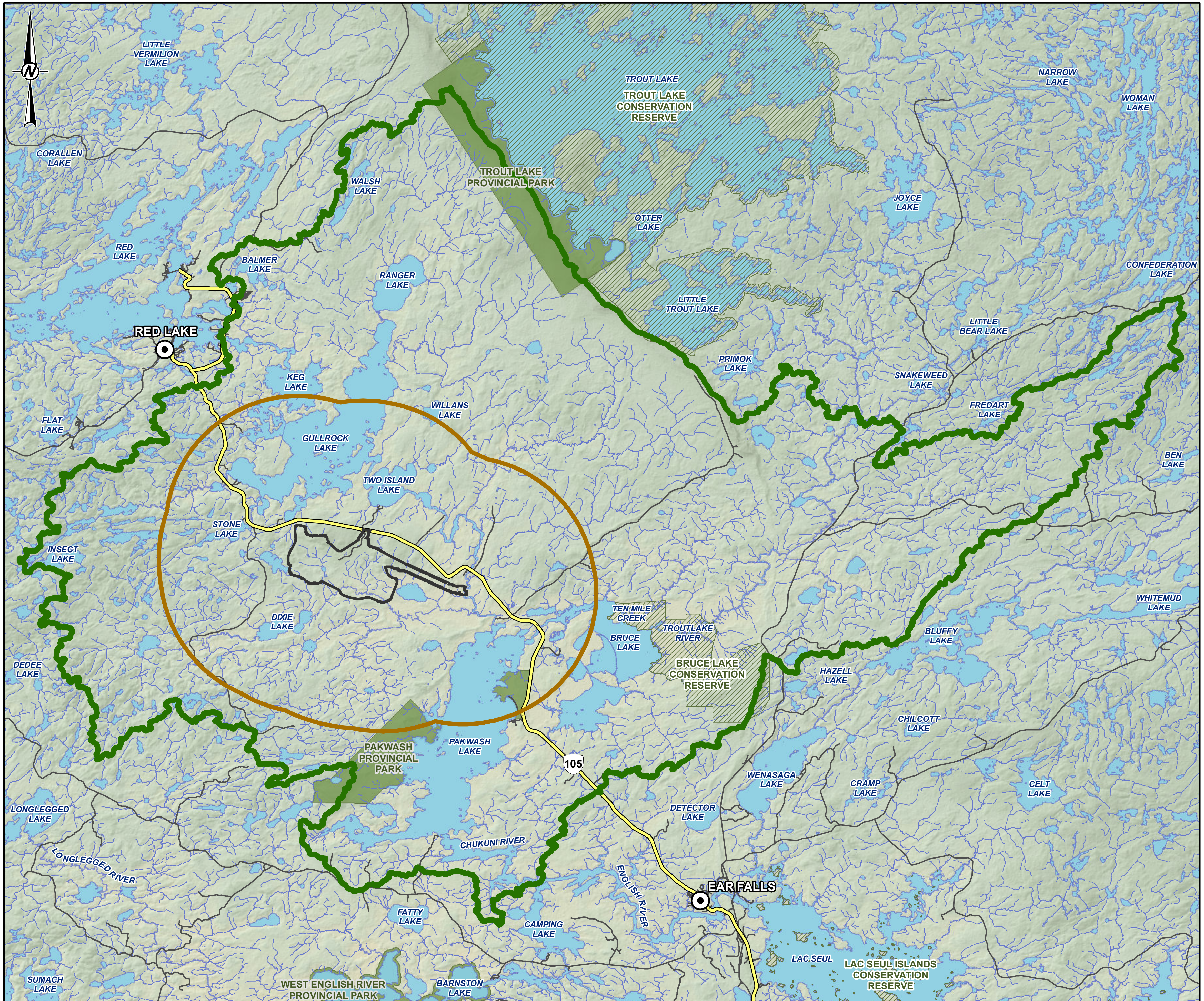
| Criteria | Indicator | Rationale |
|---|---|---|
| | MBCA: Canada Warbler, Eastern Whip-poor-will and Common Nighthawk, Eastern Wood-pewee, Evening Grosbeak, Olive-Sided Flycatcher, and Yellow Rail<br>• Residence descriptions for Barn Swallow and Bank Swallow are considered<br>• Qualitative assessment when density or habitat models are unavailable | declining populations. Due to their status, an assessment of Project effects is a requirement of the TISG, and inclusion is important for ensuring effective conservation |

Notes:
1. Lesser Yellowlegs is not on the SARA Schedule 1 and therefore is not listed under the Migratory Bird SAR Criteria.
2. Lesser Yellowlegs is a proxy species for shorebirds. See Appendix M-2 for a discussion on species grouping.

**Table 9.2-2: Significance Determination Attributes and Rankings**

| Attribute | Description | Category |
|---|---|---|
| Magnitude | A qualitative or quantitative measure to describe the size or degree of the residual effects relative to baseline conditions | • Level I: Measurable residual effect on all criteria that would be negated with mitigation measures and offset via habitat restoration during closure<br>• Level II: Measurable residual effect on habitat criteria that would not be negated with mitigation measures and offset via habitat restoration during closure and / or may affect the density of birds in the LSA<br>• Level III: Measurable residual effect on habitat criteria that would not be negated with mitigation measures and offset via habitat restoration during closure and / or may affect the persistence of avian populations in the RSA |
| Geographic Extent | The spatial extent over which the residual effect will take place | • Level I: Effect is restricted to the LSA<br>• Level II: Effect extends beyond the LSA but within the RSA<br>• Level III: Effect extends beyond the RSA |
| Duration | The time period over which the residual effect will or is expected to occur | • Level I: Effect occurs over the short term: less than or equal to 3 years (1)<br>• Level II: Effect occurs over the medium term: more than three years but less than 32 years (1)<br>• Level III: Effect occurs over the long term: greater than 32 years (1) |
| Frequency | The rate of occurrence of the residual effect | • Level I: Effect occurs once, infrequently (or not at all)<br>• Level II: Effect occurs intermittently or regularly<br>• Level III: Effect occurs frequently or continuously |
| Reversibility | The extent to which the residual effect can be reversed | • Level I: Effect is fully reversible during the Project phases<br>• Level II: Effect is partially reversible during the Project phases<br>• Level III: Effect is not reversible during the Project phases. |
| Timing | A measure of whether the residual effect occurs during a sensitive period of the year | • Level I: Effects do not occur during a sensitive period (breeding or migration period), or related effects are fully mitigated<br>• Level II: Effects occur during a sensitive period (breeding or migration period) and are partially mitigated<br>• Level III: Effects occur during a sensitive period (breeding or migration period) and are not mitigated |

Note:
1. These timelines approximately align with the Project: construction phase is approximately 3 years, operations phase is approximately 26 years, and the active closure period is an additional 3 years.




**LEGEND**

- PROJECT AREA
- LOCAL STUDY AREA FOR FOR MIGRATORY BIRDS
- REGIONAL STUDY AREA FOR MIGRATORY BIRDS
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY

0 2.5 5 10
1:300,000 KILOMETRES

**NOTE(S)**
1. ALL LOCATIONS ARE APPROXIMATE

**REFERENCE(S)**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

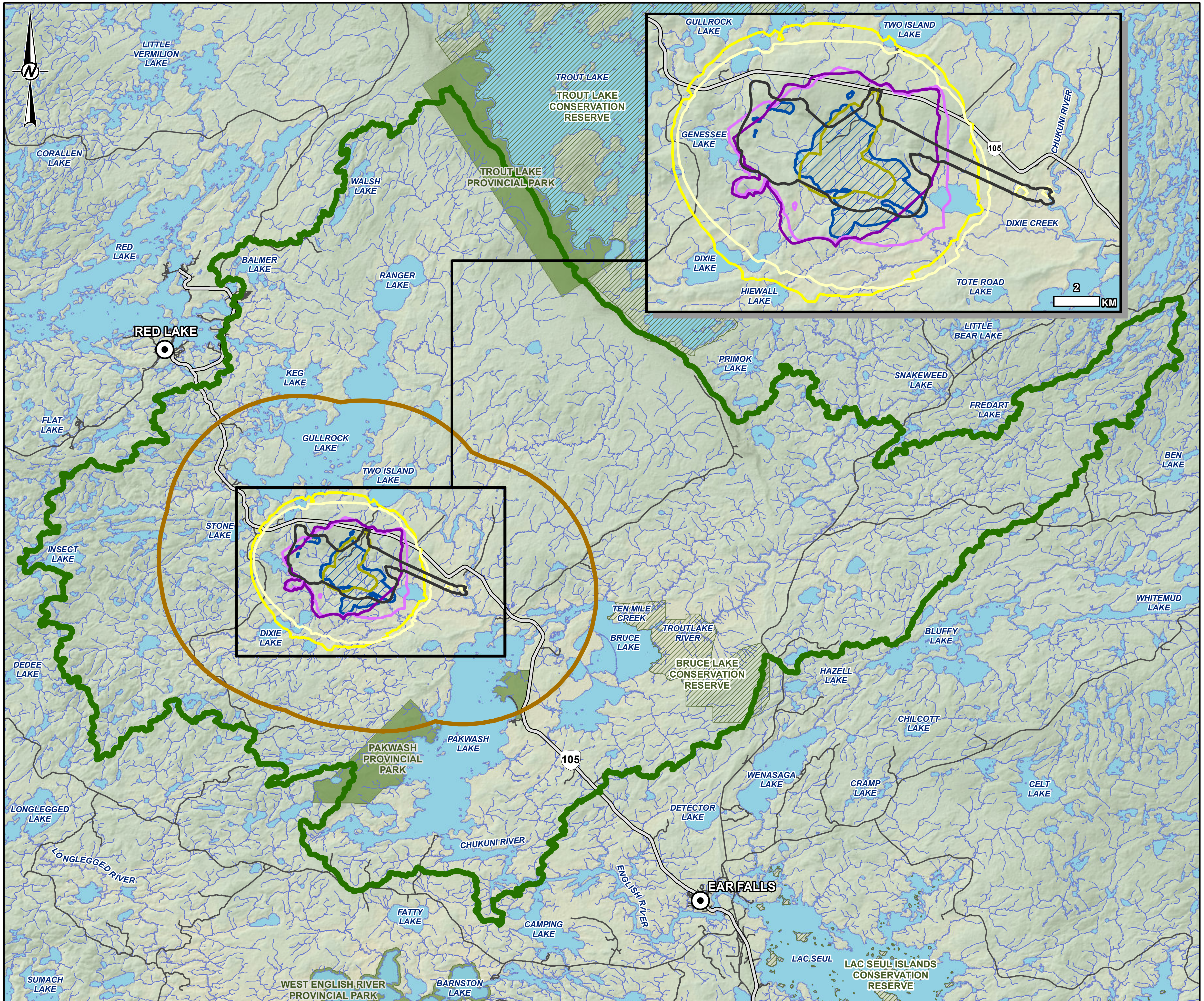
TITLE
**SPATIAL BOUNDARIES FOR MIGRATORY BIRDS**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2026-03-31 |
| DESIGNED | ---- |
| PREPARED | MD |
| REVIEWED | ---- |
| APPROVED | SD |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| CA0031271 | 0001 | A | 9.2-1 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B




**LEGEND**

- PROJECT AREA
- LOCAL STUDY AREA FOR MIGRATORY BIRDS
- REGIONAL STUDY AREA FOR MIGRATORY BIRDS
- CUMULATIVE AIR QUALITY CONCENTRATIONS FOR THE CONSTRUCTION PHASE ZOI
- CUMULATIVE AIR QUALITY CONCENTRATIONS FOR THE OPERATION PHASE ZOI
- NOISE FOR THE CONSTRUCTION PHASE (DAY TIME) ZOI
- NOISE FOR THE OPERATION PHASE (DAY TIME) ZOI
- NOISE FOR THE CLOSURE PHASE (DAY TIME) ZOI
- GROUNDWATER AND SURFACE WATER ZOI
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY

0 2.5 5 10
1:300,000 KILOMETRES

**NOTE(S)**

1. ALL LOCATIONS ARE APPROXIMATE
2. ZOI: ZONE OF INFLUENCE
3. A 40 dBA CONTINUOUS NOISE THRESHOLD WAS USED AS DISTURBANCE BENCHMARK (WORST-CASE SCENARIO FOR CONSTRUCTION, OPERATIONS AND CLOSURE).

**REFERENCE(S)**

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. ZOIS CURRENT AS OF AUGUST 19, 2025.
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
**INDIRECT EFFECTS FOR MIGRATORY BIRDS**

CONSULTANT

| | |
|---|---|
| YYYY-MM-DD | 2026-03-31 |
| DESIGNED | ---- |
| PREPARED | MD |
| REVIEWED | ---- |
| APPROVED | SD |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| CA0031271 | 0001 | A | 9.2-2 |

## 9.3 Influence of Consultation and Engagement

Consultation and engagement have been ongoing for several years, both prior to and throughout the Impact Assessment process, and will continue over the life of the Project. Section 3 provides more detail on the extensive consultation and engagement process to date. The record of consultation (Appendix C) includes detailed comments received and responses provided during the development of the Impact Statement. Feedback received through consultation regarding migratory birds has been addressed through direct responses (in writing and follow-up meetings) and incorporated into the Impact Statement, including this section as appropriate. Engagement during the preparation of the Impact Statement with Indigenous Nations and stakeholders was completed to gather the necessary information to determine how potential impacts on migratory birds (both positive and negative) interact with the interests of stakeholders.

Great Bear Resources has provided funding to support the documentation of Indigenous knowledge for local communities and to inform the preparation of the Impact Statement. Confidential reports have been prepared for Lac Seul First Nation (LSFN), Northwestern Ontario Métis Community (NWOMC) and Wabauskang First Nation (WFN), which have been shared with Great Bear Resources to help inform the Impact Statement. At the time of writing this Impact Statement, the results of the Asubpeeschoseewagong Netum Anishinabek (ANA) Land Use and Occupancy Study were not available. The provision of the full study and its content remain at the discretion of ANA. Indigenous knowledge and local knowledge shared with Great Bear Resources have been incorporated throughout this section, as appropriate. Feedback from Indigenous Nations and stakeholders has directly influenced the assessment of potential effects on migratory birds and the development of mitigation and enhancement measures, including:

- Wild Rice Enhancement Project: At the request of LSFN and WFN, Great Bear Resources has funded a collaborative study to address the loss of historic Wild Rice production on Wabauskang Lake. The enhancement project, located on the WFN reserve and supported by LSFN, will develop options for habitat restoration and knowledge-sharing on sustainable harvesting practices, supporting long-term stewardship by community members. Wild Rice stands may be migratory bird habitat.
- Contamination: In response to concerns about waterfowl exposure to contaminants (e.g., tailings and toxins), the Project has committed to robust tailings management, regular environmental monitoring, and transparent communication of results. Wildlife will be discouraged from inhabiting contact water ponds, including but not limited to the tailings management facility (TMF) pond, mine water pond and collection water pond.
- Environmental monitoring and Indigenous participation: Great Bear Resources has committed to ongoing engagement with Indigenous environmental monitors and the Environmental Management Committee, ensuring that Indigenous knowledge informs the monitoring of migratory birds and their habitats.
- Communication and adaptive management: The Project will maintain open communication with communities regarding monitoring results, adaptive management measures, and opportunities for community input throughout the Project lifecycle.

Confidential Indigenous knowledge and land use studies prepared for LSFN, NWOMC and WFN have informed the assessment of potential impacts to migratory birds, particularly waterfowl. These studies, based on geographic information system (GIS) mapping, interviews, and community workshops, document the dynamic and seasonal nature of waterfowl hunting, as well as the importance of waterfowl to community food systems, cultural continuity, and intergenerational knowledge transfer:

- LSFN: A report compiled traditional knowledge and land use information gathered through interviews with community members and Knowledge Holders (2021 to 2024). The report highlights the importance of hunting waterfowl (ducks and geese) to the community, both as a food source and as a means of passing on traditions. LSFN members reported hunting in locations within the LSA, but no key hunting areas were reported within the PA. The community identified Wild Rice stands as excellent hunting areas for waterfowl and noted the cultural and ecological significance of these habitats. Hunting areas were identified at Pakwash Lake, Chukuni River, Bruce Lake, and multiple areas downstream of the Ear Falls Area. LSFN also expressed concerns about the potential for waterfowl to be exposed to contaminants and the broader impacts of industrial development on migratory bird populations and habitats.
- NWOMC: A report prepared for NWOMC documents traditional use locations and activities in the LSA and RSA, including waterfowl hunting. The report notes that Métis members hunt waterfowl in the LSA. The NWOMC report also reflects concerns about the cumulative impacts of development on waterfowl populations and the integrity of traditional hunting areas.
- WFN: A report shared with Great Bear Resources documents community values through GIS-based mapping and interviews (2021 to 2022). The study identified waterfowl hunting areas (primarily for ducks and geese, but also loons and ptarmigans) within the LSA, but none directly within the PA. The report emphasizes that the information documented represents a snapshot in time and does not encompass the full extent of community knowledge and land use. WFN identified manoomin (Wild Rice) stands, such as those at Unnamed Waterbody 6 and along the Chukuni River and Pakwash Lake and along the English River system near Grassy Narrows First Nation Reserve, as excellent hunting areas for waterfowl. Concerns were raised about the potential for birds to land in tailings areas and the risk of community members consuming contaminated birds. In addition to mine tailings, the community also expressed concerns about birds being exposed to water contaminated by runoffs, spills, and sedimentation. Community members were also concerned about potentially consuming waterfowl that had been exposed to contaminated water. There is also a desire to better understand both the direct impacts of the proposed mine and the cumulative impacts from past developments on the land and waters.

Across all communities, several key themes emerged from consultation and engagement:

- Importance of Wild Rice stands: Wild Rice (manoomin) stands are repeatedly identified as critical habitats for waterfowl and as preferred hunting areas. Both LSFN and WFN have emphasized the cultural, ecological, and economic significance of Wild Rice, and the Project's potential to impact these habitats is a central concern. The collaborative Wild Rice Enhancement Project, funded by Great Bear Resources and developed in consultation with LSFN and WFN, aims to mitigate potential impacts on Wild Rice and its associated waterfowl habitat. Wild Rice is discussed in Section 7.9.
- Dynamic and seasonal land use: Waterfowl hunting practices are dynamic, shifting with seasonal patterns, water levels, and accessibility. Community reports stress that documented land use represents a snapshot in time and may not capture the full extent

of traditional activities. The WFN report specifically notes that "*the practice of Aboriginal and treaty rights is not site specific*," and that the mapped values are only a partial representation.

- Cumulative effects and contamination: Communities are concerned not only about the direct impacts of the Project but also about the cumulative effects of past and ongoing development on waterfowl populations, habitats, and the safety of harvested birds. There is particular concern about birds landing in tailings areas and the potential for contamination to enter the food chain. The LSFN 2024 report adds that community members have observed "*declines in the health and numbers of ducks and geese*" in traditional hunting areas.
- Knowledge transfer and cultural continuity: Waterfowl hunting is valued not only for subsistence but also as a means of transmitting cultural knowledge, skills, and values to younger generations. The maintenance of healthy waterfowl populations and accessible hunting areas is seen as essential to cultural continuity.
- Desire for ongoing engagement and monitoring: Communities have expressed a desire for ongoing engagement in monitoring migratory birds and their habitats, including opportunities for Indigenous environmental monitors and the integration of Indigenous knowledge into monitoring and adaptive management. The Shared Spirits water monitoring program (a partnership between WFN and LSFN) is highlighted as a model for integrating Indigenous knowledge and Western science.

## 9.4 Existing Conditions

The Project is located within the Bird Conservation Region 8 in Ontario, which identifies 229 species of birds that breed, overwinter, reside year-round, or migrate through (EC 2014). Confidential Indigenous knowledge reports shared with Great Bear Resources identified the presence of waterfowl hunting areas within the LSA, but none directly within the PA. The PA is located within the Red Lake Forest Management Unit (FMU) 840. The PA is characterized by a mosaic of young or recently disturbed forest blocks from commercial forestry, interspersed with small tracts of remnant mature coniferous habitat (Appendix M-2). The PA is entirely designated as a Z block for forestry under the Red Lake Forestry Management Plan where harvest is open for all years. Regionally, the Trout Lake, Kenora, Lac Seul, Wabigoon, Whiskey Jack, and Whitefeather FMUs are present or adjacent to the RSA, and have regular forestry operations as per each forest management plan (see Figure 3-2 in Appendix M-2). Other local land uses include several provincially-approved aggregate pits along Tuzyk's Road and Tote Road (Appendix M-1).

All data collection and modelling were completed at the species level, and the methods and results are presented in Appendix M-1 and Appendix M-2. Migratory birds were grouped based on the rationale provided in the TISG. Significant Wildlife Habitat types also support the precedent for grouping species. Groupings defined for this fVC are forest birds, shorebirds, waterfowl, waterbirds, marsh birds, edge / open / early successional birds, SARA Schedule 1 birds, and birds with residence descriptions.

Proxy species are provided per grouping to inform the assessment, as not all documented species could be modelled or mapped. The rationale for the selection of proxy species and habitat mapping methods is provided in Appendix M-2. The proxy species are:

- Coniferous Forest birds: Yellow-rumped Warbler
- Deciduous Forest birds: Black-and-white Warbler
- Mixed Forest birds: Winter Wren
- Shorebirds: Lesser Yellowlegs and Wilson's Snipe
- Waterfowl (including ducks and geese): Mallard
- Waterbird: Common Loon
- Marsh birds: Swamp Sparrow
- Edge / Open / Early Successional birds: Mourning Warbler.

A SAR screening for migratory birds confirms there is breeding in the RSA, as provided in Appendix M-2. SAR migratory birds identified in the PA and LSA are assessed individually, and include:

- Canada Warbler
- Common Nighthawk
- Eastern Whip-poor-will
- Eastern Wood-pewee
- Evening Grosbeak

- Olive-sided Flycatcher
- Yellow Rail
- SAR migratory birds identified in the PA, with a SAR residence description, include Barn Swallow and Bank Swallow.

Additionally, a screening and assessment of potential Significant Wildlife Habitats are included in Appendix M-2. The PA contains two confirmed Significant Wildlife Habitat types applicable to this fVC:

- Waterfowl Stopover and Staging Areas: Aquatic
- Waterfowl Nesting Area.

The RSA contains four confirmed Significant Wildlife Habitat types applicable to this fVC:

- Waterfowl Stopover and Staging Areas: Aquatic
- Waterfowl Nesting Area
- Colonially Nesting Bird Breeding Habitat: Tree / shrub
- Marsh Bird Breeding Habitat.

### 9.4.1 Habitat

The most abundant habitat within the PA, LSA and RSA is coniferous forest, followed by deciduous forest. Black Spruce and Jack Pine heavily dominate coniferous forest communities. Deciduous communities typically include Trembling Aspen and White Birch. The majority of the PA consists of early successional forests, and the PA is more fragmented than the RSA (Table 9.4-1). Wetlands cover up to 25% of the PA, LSA and RSA, with the dominant cover type being intermediate conifer swamp. A further description of the habitat within the PA is provided in Section 7.8 and detailed in Appendix M-2.

Suitable habitat was highly abundant within the PA for birds with forest and wetland habitat preferences (Table 9.7-1). Given the prevalent forest habitat across the PA, Yellow-rumped Warbler, Mourning Warbler and Winter Wren were the most widely recorded proxy species observed at 123, 100, and 97 unique point-count locations, respectively. The least observed forest proxy bird was Black-and-white Warbler (deciduous), observed at 27 unique point count locations. BAM also identified Swamp Sparrow habitat within the PA. Swamp Sparrow was observed at 28 point-count locations within the PA. The large amount of identified habitat for these birds was the result of both habitat abundance and the coarse scale used by BAM (4 km; Stralberg 2012). Shore habitat is much less prevalent in the PA, with less than 1,000 ha of habitat available for both proxy shorebird species. The least observed proxy species were shore species (Wilson's Snipe and Lesser Yellowlegs). Wilson's Snipe was observed at 18 point-count locations. Lesser Yellowlegs were not observed at any point count locations but were heard on two autonomous recording units (ARU) placed in predicted Lesser Yellowlegs habitat. No confirmed nesting habitat was identified in the PA.

For Common Loon (waterbirds), no habitat was found in the PA, as the preferred large and deep bodies of water are not present; however, 98 ha of Mallard habitat (waterfowl) was found in the PA. Waterfowl were documented to use smaller waterbodies and watercourses during fieldwork, including Unnamed Waterbody 1, Unnamed Waterbody 6, Unnamed Waterbody 7 and Dixie Creek.

### 9.4.2 Density and Populations

Bird densities within the PA, LSA, and RSA are presented in Table 9.7-3. The Yellow-rumped Warbler and Mourning Warbler had the highest densities within the PA of the assessed species. This likely reflects the coniferous and early successional nature of the PA habitat. Modelling suggested that the density of Swamp Sparrow within the PA was almost five times lower than in the RSA. For the other proxy bird species, the densities within the RSA and PA were similar. Shorebirds had the lowest densities. The density for Lesser Yellowlegs was assessed as near zero in almost all of the RSA.

### 9.4.3 Migratory Bird SAR

Based on field detections (Appendix M-1 and Appendix M-2), the following migratory SAR birds are identified in the RSA: Barn Swallow, Bank Swallow, Canada Warbler, Common Nighthawk, Eastern Whip-poor-will, Eastern Wood-pewee, Evening Grosbeak, Olive-Sided Flycatcher and Yellow Rail.

A description of the baseline conditions is presented below to characterize the existing conditions for SAR birds based on the multi-year baseline investigations completed by Northern Bioscience (Appendix M-1). The existing conditions are used to support the assessment of potential effects of the Project on SAR birds and to support long-term monitoring of the Project.

Barn Swallow is protected under the MBCA. Barn Swallow is listed as Threatened under the federal SARA and has a Residence Description. Birds with a Residence Description under SARA have their residences (the nest) protected on both private and public lands. Under SARA, the nest, occupied or not, is considered a residence from May 1 (or the date when adults are first seen building or occupying the nest, whichever is earlier), until August 31 (or the date when a bird is last seen at the nest, whichever is later (Government of Canada 2019). During the period of occupancy of the residence, any activity that damages or destroys the functions of the nest would constitute damage or destruction of the residence. These activities include, but are not limited to, moving, damaging, or destroying the nest; blocking access to the nest; disturbing the nest; or any other activity that would damage or destroy the functions of the nest (Government of Canada 2019). Barn Swallows forage across a diverse array of open habitats. Their nests are typically found inside or outside anthropogenic structures, which are not currently present in the PA (Heagy et al. 2014). Including flyovers, 5 observations of a total of 15 Barn Swallows were recorded during point counts. Ten Barn Swallows were seen foraging near the bridge east of Unnamed Waterbody 6, outside the PA. Barn Swallows were additionally confirmed by automated ARU analysis near Unnamed Waterbody 1. The ARUs detected Barn Swallow five times. No evidence of nesting or suitable natural nesting habitat was identified during baseline surveys.

Bank Swallow was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened in 2013 and are listed as Threatened under Schedule 1 of the SARA. Bank Swallow have a residence description (see Barn Swallow above). Bank Swallow are listed under Article I of the MBCA. Bank Swallow typically nest along river bluffs, lakeshores or coastlines. Colonies can exhibit high site fidelity, with larger colonies more likely to remain at the same location than smaller ones. Colony locations may change if the area becomes unsuitable (ECCC 2022a). Two active colonies of Bank Swallow were noted during baseline investigations: one was located at the Lafarge aggregate pit on the west side of Tuzyk's Road, and the other was at a smaller aggregate pit on the east side of Tuzyk's Road closer to Highway 105, both located within the PA. ARU analysis confirms Bank Swallow approximately

1.2 km east of Tuzyk's Road along the regional transmission line corridor in the PA. The ARUs detected Bank Swallow eight times.

Canada Warbler was listed as Threatened under Schedule 1 of SARA in 2010 and was assessed by COSEWIC as Special Concern in 2020. Canada Warbler is listed under Article I of the MBCA. Canada Warbler breeding habitat can vary by region but is often associated with deciduous shrub layers in moist forests. Canada Warblers primarily forage for insects in the shrub layer (EC 2016b). Canada Warbler was detected incidentally as well as formally at more than 30 breeding bird point count locations inside and outside the PA. ARU analysis confirmed Canada Warbler at three ARU stations. The ARUs detected Canada Warbler 26 times.

Common Nighthawk was downlisted from Threatened to Special Concern under Schedule 1 of the SARA in 2023. Common Nighthawk is listed under Article I of the MBCA. The Common Nighthawk is crepuscular / nocturnal and forages in open spaces where flying insects are abundant. These birds typically nest on the ground in open areas or forest clearings (EC 2016a). Common Nighthawk were identified through incidental observations, night jar surveys and ARU recordings. Common Nighthawks were heard from Dixie Road to Tote Road, and along Tuzyk's Road inside the and to the west and east of the PA. In addition, Common Nighthawk was confirmed at 66 of the 86 functional ARU stations for recording nocturnal birds. The ARUs detected Common Nighthawk a total of 1,064 times.

Eastern Whip-poor-will was assessed by COSEWIC as Threatened in 2009, and in 2011 it was listed as Threatened under Schedule 1 of the SARA. Eastern Whip-poor-will is listed under Article I of the MBCA. From the provincial Recovery Strategy (MECP 2019), the nesting and foraging habitats of the Eastern Whip-poor-will typically feature well-drained soils, moderate tree cover, and sparse shrub and herb cover. These include early-succession forests, forest edges, rock or sand barrens, savannahs, old burns, and sparse conifer plantations. Eastern Whip-poor-will is crepuscular / nocturnal and forages in prairies, shrub wetlands, regenerating clear-cuts, and agricultural fields. Eastern Whip-poor-will were heard from Dixie Road to Tote Road, and along Tuzyk's Road inside the and to the west and east of the PA. Eastern Whip-poor-will was detected at 15 monitoring stations; ARUs detected Eastern Whip-poor-will a total of 171 times.

Eastern Wood-pewee was listed as Special Concern under Schedule 1 of SARA in 2017. Eastern Wood-pewee is listed under Article I of the MBCA. Eastern Wood-pewee habitat preference appears driven by the availability of open space, which provides insect foraging opportunities. Most commonly, Eastern Wood-pewees live in deciduous and mixed forests, preferring tall canopies near forest edges. Although more abundant in large habitat patches, they can persist in small patches (ECCC 2023a). Eastern Wood-pewee were heard five times during surveys at widely dispersed survey locations inside and outside the PA. There were no ARU recordings of Eastern Wood-pewee.

Evening Grosbeak was listed as Special Concern under Schedule 1 of SARA in 2019. Evening Grosbeak is listed under Article I of the MBCA. Evening Grosbeak breeding habitat generally includes open, mature mixedwood forests, where fir species and / or White Spruce are dominant, and Spruce Budworm is abundant (ECCC 2022b). During point counts along Tuzyk's road and Highway 105, Evening Grosbeak was observed on six occasions inside and outside the PA. There were no ARU recordings of Evening Grosbeak.

Olive-sided Flycatcher was downlisted from Threatened to Special Concern under Schedule 1 of SARA in 2023. Olive-sided Flycatcher is listed under Article I of the MBCA. Olive-sided Flycatcher is an insectivorous species that can be found in both old-growth and early to mid-successional forests. They tend to use live trees along edge habitat for nesting and foraging

(COSEWIC 2018). Olive-sided Flycatcher was detected at more than 26 breeding bird point count locations inside and outside the PA. ARU analysis confirms Olive-sided Flycatcher at two ARU stations. ARUs detected Olive-sided Flycatcher ten times.

Yellow Rail was listed as Special Concern under Schedule 1 of SARA in 2003 and reassessed as Special Concern by COSEWIC in 2023. Yellow Rail is listed under Article I of the MBCA. The Yellow Rail is a small, secretive marsh bird that breeds in shallow, grassy marshes and wet meadows (Government of Canada 2025). Yellow Rail was detected at one point count location outside the PA to the west. ARUs did not detect any Yellow Rail.

HSMs were developed to quantify the habitat for the following SAR birds: Canada Warbler, Eastern Wood-pewee, Evening Grosbeak, Olive-sided Flycatcher, and Yellow Rail. A single nightjar HSM was used for both the Eastern Whip-poor-will and Common Nighthawk. A detailed description of the HSM methods is included in Appendix M-2. A description of the residence for Barn Swallow and Bank Swallow is included in Appendix M-2. With the available point count data, it was possible to develop a density model for the Olive-sided Flycatcher. A BAM density was used if available for other migratory SAR species. Density models were not available for Common Nighthawk, Eastern Whip-poor-will and Yellow Rail.

### Table 9.4-1: Baseline Fragmentation within the PA

| Habitat Type | Mean Patch Size in RSA (ha) | Mean Patch Size in PA (ha) | Effective Mesh Size in RSA (ha) | Effective Mesh Size in PA (ha) |
|---|---|---|---|---|
| Coniferous Forest (1) | 7.90 | 5.63 | 18.48 | 14.56 |
| Deciduous (2) | 6.30 | 5.60 | 15.79 | 11.00 |
| Marsh (3) | 4.44 | 2.60 | 14.21 | 5.54 |
| Shore (4) | 20.29 | 9.79 | 1,843.21 | 89.21 |

Notes:
1. Values averaged over Conifer Swamp and Upland Conifer Forest
2. Values averaged over Hardwood Swamp and Upland Deciduous Forest
3. Values averaged over Thicket Swamp, Meadow Marsh, Bog, Conifer Swamp and Hardwood Swamp
4. Values averaged over the HSM for the two shorebirds (Lesser Yellowlegs and Wilson's Snipe).

## 9.5 Identification of Potential Effects

The initial step in the assessment process is to identify interactions between the Project and migratory birds that can result in pathways to potential effects. These potential effects may be direct, indirect or induced, and can be negative or positive. Table 9.5-1 summarizes the potential interactions of the Project with migratory birds, prior to the application of the mitigation measures.

The professional judgment of technical experts experienced with mining projects in Ontario and Canada, as well as input from Indigenous communities, government agencies and the public, informed the identification of Project activities that may have a measurable change to migratory birds. These pathways to potential effects are further described in Section 9.5.1 to Section 9.5.3 for each phase of the Project.

There will be two induced effects from the Project that will result in changes to habitat abundance related to proposed fish offsetting and compensation measures (Dixie Creek pond complex and the east pond and channel). The Dixie Creek pond complex will result in approximately 5 ha of habitat change outside the PA. The east pond fish habitat compensation area will be within the PA. These induced effects may increase available habitat for some birds. It is not expected that induced effects will result in a residual effect on habitat abundance. As a result, induced effects are not carried forward to determinations of significance.

### 9.5.1 Construction Phase

The construction phase of the Project is expected to span a three-year period and will include site preparation and construction of mine infrastructure. The removal of habitat for infrastructure is generally considered a direct effect under the Project component, site preparation activities, in the PA. Some components will have no potential effects beyond their removal of habitat during site preparation activities. The following interactions with the Project result in pathways to potential effects on the migratory birds as described below.

- Site preparation activities that remove vegetation and create ground disturbance (e.g., clearing, grubbing and bulk earthworks) can affect migratory birds and migratory bird SAR due to a change in the amount of relative habitat abundance, connectivity and quality of habitat, change in density and population and risk of mortality. These activities consider everything in the PA, including the establishment of onsite haul and access roads, embankments for the TMF, water management and treatment facilities, stockpiles, aggregate operations, onsite infrastructure, waste management, power supply and process plant.
- Fragmentation of previously continuous habitat can create gaps and lead to edge effects, which may affect the ability of some wildlife species to carry out integral life processes (Kurki et al. 2000; Hargis et al. 1999).
- Site preparation activities, open pit mining, underground mining, management of rock and unconsolidated materials in stockpiles, establishment of onsite aggregate operations, and others use blasting and machinery and equipment that can result in sensory disturbance (noise) and air emissions (dust). These disturbances can indirectly affect migratory birds by reducing the quality of available habitats. Habitat with sensory disturbances, such as noise and light, could be considered low-quality habitat as these disturbances can disrupt bird communication or elevate stress (Swaddle et al. 2015).

Dust can settle on nearby vegetation, reducing growth. These combined effects could lead birds to avoid habitats that are disrupted.

- Site preparation activities that regrade and alter catchment areas may indirectly affect migratory birds by changing the contribution of surface water. This can affect the quality and function of suitable habitat; for example, changes in the pooling and / or flow of surface water can alter vegetative structure or remove breeding habitat.
- Site preparation and construction activities for the Project will increase the amount of edge habitat and increase the amount of domestic and food waste, although this will be limited to temporary storage (Forman and Alexander 1998). This can attract bird predators such as Coyote, Red Fox, Striped Skunk, American Marten and Common Raven identified as present (Appendix M-1), and increase the mortality risk for migratory birds. Changes in mortality risk can affect bird populations and density.
- Construction of roads and other site facilities (open pit mining, development and management of stockpiles, establishment of aggregate operations, construction of the starter embankments for the TMF, and construction and operation of buildings and infrastructure) may directly increase the risk of bird mortality through wildlife-vehicle collisions (Bishop and Brogan 2013).

### 9.5.2 Operations Phase

The operations phase is anticipated to occur over a 26-year period. Effects during the operations phase are largely indirect, resulting from changes to pVCs, such as air quality, noise and groundwater. These operational effects may result in pathways to a change in connectivity and quality of habitat, change in density and population, risk of mortality, and change in migratory bird SAR. No operations phase direct impacts on the relative abundance of habitats are anticipated, as habitats within the PA are assumed to be removed or permanently altered during the construction phase. The following interactions with the Project result in pathways to potential effects on the migratory birds:

- The ongoing dewatering and groundwater management associated with mining and water treatment interacts with migratory birds and their nests. Continued groundwater management can alter the water levels in surrounding wetlands and water bodies. Changes in surface water flow can alter vegetation, which in turn indirectly affects the quality of migratory bird habitats. Changes in surface water flow may have greater effects on birds that nest in wet areas, such as marsh and shorebirds.
- Underground and open pit mining activities, including blasting, rock extraction and hauling, may also degrade nearby habitat quality through dust emissions, noise and vibration. As discussed in Section 9.2.4.2, vibration will not extend outside the PA and, therefore, impacts to habitat are already accounted for (as all habitat in the PA is considered removed). Stockpile management, operation of water management and treatment facilities, construction of the mine water pond, and operation and maintenance of buildings and infrastructure may also impact habitat quality.
- There will be continuous changes to nighttime light levels during the operations phase. The existing light conditions include limited infrastructure at the site, with no substantial buildings or lighting; however, the Municipality of Red Lake may cause some sky glow in the northern parts of the Property (Appendix G). Light trespass is not predicted to exceed the maximum recommended for an E1 Environmental Lighting Zone during the

operations phase, therefore, it is not discussed further or carried forward to residual effects.

- The operation of the mine will require the management of vegetation with the PA. Mortality risk is increased for birds and their nests within this managed vegetation. This mortality risk is elevated during sensitive timing windows. There are legislative requirements to warrant following appropriate timing windows (Section 9.2.1.1.2) and best management practices for vegetation removals to prevent the destruction of individuals and habitats (ECCC 2023b).
- Movement of vehicles and haul trucks poses a risk to migratory birds. The movement of vehicles and equipment can result in accidental mortality through collisions (Bishop and Brogan 2013).
- The operation of the mine will create domestic waste (food waste), indirectly affecting the mortality risk for migratory birds. Predators can be attracted to domestic waste for food. These human-subsidized predators may prey on birds and their nests. This effect will be limited, as there will be only temporary storage of food waste of a restricted quantity prior to transport off site for disposal.
- Buildings in the PA used for operations interact with the risk of mortality for migratory birds. The glass in the windows of buildings poses a collision threat to birds, which can directly or indirectly increase the chances of bird mortality.
- The risk of mortality is also considered present from use of chemicals, and potential contamination from malfunctions and accidents considered in Section 16. The potential effect of cyanide use in the process plant has been identified of concern during consultation and engagement. Cyanide use and destruction is explained in Section 5.6.2. The tailings will be treated for cyanide destruction prior to storage in the TMF. Weak acid dissociable cyanide concentrations of less than 50 mg/L are considered to be safe for wildlife exposure (Donato et al. 2007). The target concentration of total cyanide in the tailings after the cyanide destruction circuit in the process plant will be compliant with the International Cyanide Management Code (ICMI 2021), which also uses this threshold. In regard to methylmercury (the form of mercury most readily taken up by aquatic organisms and biomagnified through the food chain, with the highest concentrations in top predators (e.g., Northern Pike and Walleye) and fish-eating birds and mammals), wildlife in the region is already exposed to methylmercury at levels above the most stringent guidelines in the existing baseline condition. The elevated levels are related to natural and historical sources. The incremental contribution to existing mercury and methylmercury concentration in water, sediment and biota by the Project is predicted to be negligible and not measurable with current analytical methods (Appendix K-3 and Appendix N-1).

### 9.5.3 Closure Phase

Activities during the active closure period, which is expected to occur over a three-year period immediately after operations cease, are comparable to those during the construction phase; similar mining and construction equipment are used during this period, but on a much smaller scale. Passive closure is expected to last for one year, followed by the final reclamation and close-out period. Final reclamation may result in positive changes in the relative abundance of habitats, connectivity and habitat quality, density and population, and migratory bird SAR. The following interactions with the Project result in pathways that potentially lead to changes in migratory birds during the closure phase:

- During the active and passive closure periods of the Project, efforts will focus on stabilizing and rehabilitating disturbed areas through regrading, covering, and revegetation. These activities are expected to improve habitat conditions and promote the re-establishment of Other Wildlife habitats. There will be a reduction in vehicular traffic and equipment use during the operations phase, which will lower the risk of mortality.
- Passive closure activities, including the filling of the mine workings and groundwater level rebound, are expected to restore hydrological conditions that support wetland and aquatic habitats used by migratory birds.
- The demolition-related activities will produce moderate, temporary sensory disturbances, which may discourage habitat use by some migratory bird species. Upon final closure, disturbance ceases, and habitat conditions improve, allowing migratory birds to return to and around the PA.
- The movement of vehicles and equipment through the PA can result in accidental mortality through collisions (Bishop and Brogan 2013).

**Table 9.5-1: Interactions between Project Components and Key Activities and Migratory Birds**

| Project Component and Key Activities | Interaction with Migratory Birds | | | | |
|---|---|---|---|---|---|
| | **Relative abundance of Habitat** | **Connectivity and in quality of Habitat** | **Density and Population** | **Risk of Mortality** | **Migratory Bird SAR** |
| **Construction Phase** | | | | | |
| Site preparation activities | Yes | Yes | Yes | Yes | Yes |
| Establishment and operation of water management and treatment facilities (1) | No | No | No | No | No |
| Open pit mining | No | Yes | Yes | Yes | Yes |
| Underground mining | No | Yes | Yes | No | Yes |
| Management of rock and unconsolidated materials in stockpiles | No | Yes | Yes | Yes | Yes |
| Establishment of onsite fish habitat and compensation measures (2) | No | No | No | No | No |
| Establishment of onsite aggregate operations | No | Yes | Yes | Yes | Yes |
| Construction of the starter embankments for the TMF | No | Yes | Yes | Yes | Yes |
| Construction and operation of buildings and infrastructure | No | Yes | Yes | Yes | Yes |
| Waste management (3) | No | No | No | No | No |
| Power supply (4) | No | No | No | No | No |
| Employment and expenditures | No | No | No | No | No |
| **Operations Phase** | | | | | |
| Underground mining | No | Yes | Yes | No | Yes |
| Mining of the LP Central pit | No | Yes | Yes | No | Yes |
| Management of rock and unconsolidated materials in stockpiles | No | Yes | Yes | No | Yes |
| Process plant operation (5) | No | No | No | No | No |

| Project Component and Key Activities | Interaction with Migratory Birds | | | | |
|---|---|---|---|---|---|
| | Relative abundance of Habitat | Connectivity and in quality of Habitat | Density and Population | Risk of Mortality | Migratory Bird SAR |
| Management of desulphurized tailings in the TMF (6) | No | No | No | No | No |
| Management of concentrate tailings and contact water in the Viggo management facility (VMF) | No | No | No | No | No |
| Operation of water management and treatment facilities | No | Yes | No | No | No |
| Construction of a mine water pond | No | Yes | No | No | No |
| Operation and maintenance of buildings and infrastructure | No | Yes | No | Yes | No |
| Waste management (3) | No | No | No | No | No |
| Power supply (4) | No | No | No | No | No |
| Progressive reclamation activities | No | No | No | No | No |
| Employment and expenditures | No | No | No | No | No |
| **Closure Phase** | | | | | |
| Active closure | Yes | Yes | Yes | Yes | Yes |
| Passive closure | Yes | Yes | Yes | Yes | Yes |
| Final reclamation | Yes | Yes | Yes | Yes | Yes |
| Employment and expenditures | No | No | No | No | No |

Notes:
1. Excluding in association with site preparation activities
2. Induced disturbance of wildlife habitat associated with placement of a berm, creation of a pond, and establishment of a channel to Unnamed Watercourse 6B-01, along with the establishment of additional related fish habitat in Unnamed Waterbody 6, as it is in the PA. The creation of the Dixie Creek pond complex is approximately 5 ha outside the PA.
3. There is no material additional potential interaction related to the waste management, as habitat removal occurs during site preparation activities, and there is no onsite landfill.
4. There is no potential interaction related to the continuation of power generation from natural gas and draw of available power from the regional grid outside of habitat removal in site preparation activities and indirect effect ZOIs.

5. Operation of the process plant may contribute to ongoing operations sensory disturbance but does not cause unique sensory disturbances.
6. The ongoing operation of the TMF, including the placement of mine rock and aggregate to periodically raise the TMF embankments using heavy equipment, may contribute to the ongoing operations' sensory disturbance, but does not introduce unique sensory disturbances.

## 9.6 Mitigation and Enhancement

Mitigation measures to avoid or mitigate the effects of the Project on migratory birds are listed below. Table 9.6-1 summarizes the proposed mitigation strategies associated with the identified effect pathways. These measures are expected to effectively meet their objectives, as demonstrated by successful implementation at similar projects. Additional mitigation measures related to pVCs with potential linkages to migratory birds are discussed within their respective sections: air quality (Section 7.2.6), sound (Section 7.3.6), groundwater (Section 7.5.6), surface water flows and levels (Section 7.6.6) and water quality (Section 7.7.6).

As noted in Section 9.2.4, the Project's effects modelling was conducted using worst case scenarios to ensure a conservative approach. This modelling informs the development of mitigation strategies. Where mitigation is expected to fully void an effect, no significance of the residual effect is identified. When mitigation reduces but does not eliminate an effect, the residual effect is characterized through qualitative discussions in Section 9.7.

Measures to be implemented to avoid or minimize the effects of the Project on migratory birds include the following:

- Implement mitigation measures for potential effects on vegetation communities and wetlands (Section 7.8) relevant to habitat abundance, including to:
  - Minimize the clearing of vegetation within the PA to that needed for construction and safe operation.
  - Minimize the removal of woody vegetation to maintain natural cover in areas adjacent to the PA. The removal of woody vegetation will be limited to hazard trees and clearing to provide safe construction access and infrastructure needs
  - Implementation of appropriate buffers around sensitive habitats: upland areas around wetlands (e.g., Unnamed Waterbody 6) should be protected for 120 m from the wetland (buffer is season-dependent and should be greater than 250 m during the nesting season (April to July for waterbirds); the implementation of buffers will be sufficient to mitigate the acoustic effects on waterbirds (Rodgers and Schwikert 2002).
  - Follow regulatory timing windows for vegetation removals applicable by location and species, and / or utilize other mitigation measures through obtaining regulatory approval or permits
  - Monitor and potentially use deterrents to discourage migratory bird nesting within the PA during all Project phases, and consider rotating deterrent methods to prevent habituation
- Implementation of mitigation measures for potential effects on air quality (Section 7.2) relevant to birds, including:
  - Apply dust management mitigation measures such as the application of water spray, supplemented by provincially-approved dust suppressants if required
  - Maintain site roads in good condition with regular inspections and timely maintenance
  - Post and limit vehicle speeds.

- Implement the mitigation measures for potential effects on noise (Section 7.3) relevant to migratory birds, including:
  - Building dimensions, layout and orientation will be designed to shield noise sources, where practical
  - Process plant will be enclosed to limit overall noise emissions from key noise sources, such as the mills
  - Use silencers at generator intakes and exhausts as applicable, to reduce noise emissions
  - Select or design motorized equipment with mufflers or silencers to limit noise emissions, where practical.
  - Vehicles and equipment will be operated in such a way that impulsive noise is minimized, where practical
  - Regular inspections will take place to confirm that equipment and machinery used on site are operated in good working condition through regular maintenance.
- Implement mitigation measures for lighting to minimize sensory disturbance (Appendix G), particularly during spring and fall migration, as reasonable, including:
  - Maintain light sources below natural barriers such as tree lines or artificial barriers such as berms, as applicable
  - Minimize light spill and glare using shielding on stationary light sources and direct lighting downwards where practicable
  - When lighting is required on tall structures, use flashing lights if reasonable
  - When it is not possible to use barriered, downward-directed or flashing lights, use long-wavelength yellow light (> 560 nm) where applicable.
- Implement the mitigation measures for potential effects on groundwater and surface water (Section 7.5, Section 7.6 and Section 7.7) relevant to migratory birds, including:
  - An integrated water management system will be designed to collect and treat contact water
  - Non-contact water will be diverted away from Project components using ditches, diversion berms and other suitable measures as reasonable
  - Reduce residual cyanide concentrations in contact water stored in the TMF through a cyanide destruction circuit in the process plant, to concentrations below recommended levels for protection of wildlife
  - Collect and treat contact water and discharge in accordance with permitting requirements
  - Implement measures outlined in a spill prevention and contingency plan to be developed prior to construction.

- Implementation of mitigation measures for potential effects on wildlife and wildlife habitat relevant to migratory birds, including:
  - Domestic solid waste products will be transported to an offsite landfill to mitigate the habitat sink effect of increased predator densities that can be created due to access to landfill sites
  - Domestic solid waste products and similar materials temporarily stored in the PA, will be properly secured, stored and transported offsite for disposal on a regular frequency
  - Wildlife will be discouraged from inhabiting contact water ponds (including but not limited to the TMF pond, mine water pond and collection water pond).
  - Minimize the disturbance by using existing trails and roads for travel outside the PA where practical
  - Provide wildlife (including migratory bird) awareness training to Project employees and onsite contractors
  - Log (and report as needed) observed wildlife - vehicle collisions and alter mitigation measures as appropriate from lessons learned
  - Implementation measures to reduce the potential for wildlife - vehicle collisions, including limiting vehicle speeds and including wildlife - vehicle collision information in wildlife awareness training.
- Implementation of mitigation measures to minimize the risk of birds colliding with onsite building windows, including:
  - Reflective (mirror) surfaces will not be used on windows to reduce the chance of collisions
  - Employees will be encouraged to close window coverings when present at night during the migratory bird season
  - Consideration will be given to applying patterns of marks, decals, or films to the windows to make them more visible to birds, if the windows are observed to be a problem after construction
- Implementation of mitigation relevant to recovery plans for migratory SAR birds, including:
  - Avoid the removal of protected habitat for SAR birds unless authorized under a registration, permits or other appropriate provincial and federal approval
  - Use vegetation clearing windows to avoid the removal of nests as practical. Cover and / or re-slope potential Bank Swallow nesting habitat within the PA before the breeding season
  - Comply with the requirements of the MBCA and Migratory Birds Regulations, if migratory SAR birds are encountered during Project activities.
- During closure, implement the progressive and final rehabilitation measures for mine development in accordance with the certified provincial Closure Plan, including revegetation preferentially using commercially available native vegetation and plant species of interest to Indigenous communities and wildlife.

The application of mitigation measures for the pathways for potential effects is summarized in Table 9.6-1. The mitigation measures described in this section are expected to be effective for their intended purposes, given their successful implementation in similar projects.

Monitoring programs will be implemented to verify the accuracy of the predicted effects and assess the effectiveness of the implemented mitigation measures and may be further optimized in response to monitoring data. The proposed follow-up monitoring described in Section 20 will be refined during the permitting phase to incorporate the conditions of the approvals and permits. Consultation on the monitoring programs is expected to continue through all phases of the Project. Great Bear Resources will continue to seek opportunities for Indigenous communities to participate in monitoring programs, supporting long-term, meaningful engagement and education.

**Table 9.6-1: Mitigation Measures for Migratory Birds**

| Pathways To Potential Effect / Criteria | Phase | | | Proposed Mitigation Measure |
|---|---|---|---|---|
| | Con | Op | Cl | |
| Change in Habitat Abundance | • | - | - | During construction, develop a compact mine site to limit the extent of disturbance in the area. |
| | • | - | - | During construction, implement mitigation measures for potential effects on vegetation communities and wetlands (Section 7.8) relevant to habitat abundance |
| | - | • | • | Implement progressive and final rehabilitation measures in accordance with the filed Closure Plan. |
| | - | • | • | Revegetate disturbed areas in the PA during closure, preferentially using commercially available native species, incorporating plant species of Indigenous interest and that support wildlife habitat where reasonable. |
| Change in Connectivity and Quality of Habitat | • | • | • | Note: all mitigation measures related to Change in Abundance of Habitat are also applicable to Changes to Connectivity and Quality of Habitat. |
| | • | • | - | Implement mitigation measures for potential effects on air quality (Section 7.2) relevant to birds. |
| | • | • | - | Implement mitigation measures for potential effects on noise (Section 7.3) relevant to birds. |
| | • | • | - | Implement mitigation measures for lighting to minimize sensory disturbance (Appendix G). |
| | • | - | - | Implement the mitigation measures for potential effects on surface water (Section 7.5, Section 7.6 and Section 7.7) relevant to migratory birds. |
| | - | • | • | Implementation of mitigation measures for potential effects on vegetation communities and wetlands (Section 7.8) relevant to migratory bird habitat quality. |
| | • | • | - | Implementation of mitigation measures for potential effects on wildlife and wildlife habitat relevant to migratory birds' habitat quality. |
| | - | - | • | During closure, implement the progressive and final rehabilitation measures for mine development in accordance with the certified provincial Closure Plan. |
| Change in Density and Population | • | • | • | Note: all mitigation measures related to Change in Abundance of Habitat, Change in Connectivity and Quality of Habitat, and Change in Risk of Mortality are also applicable to Changes to Density and Population. |

| Pathways To Potential Effect / Criteria | Phase | | | Proposed Mitigation Measure |
|---|---|---|---|---|
| | Con | Op | Cl | |
| Change in Risk of Mortality | • | - | - | Follow appropriate timing windows for vegetation removals according to species and location (remove vegetation September 15 to April 14) or gain regulatory approval (in some cases other appropriate mitigation may be implemented) |
| | - | • | • | Monitoring and potential use of deterrents to discourage migratory bird nesting, and use rotating deterrent methods to prevent habituation. |
| | - | • | • | Implement mitigation measures for lighting to minimize sensory disturbance (Appendix G). |
| | • | • | - | Implementation of mitigation measures for potential effects on vegetation communities and wetlands (Section 7.8) relevant to migratory bird mortality risks. |
| | • | • | - | Implementation of mitigation measures for potential effects on wildlife and wildlife habitat relevant to migratory bird mortality risks. |
| | • | • | • | Implementation of mitigation to reduce wildlife - vehicle collisions. |
| | • | • | - | Implementation of mitigation measures to minimize the risk of birds colliding with windows. |
| Change to Migratory Bird SAR | • | • | • | Note: the implementation of mitigation measures related to Change in Abundance of Habitat, Change in Connectivity and Quality Habitat, and Change in Risk of Mortality, will also mitigate changes to migratory bird SAR. |
| | • | • | - | Implement mitigation relevant to recovery plans for migratory SAR birds, including:<br>• Avoid the removal of protected habitat unless authorized under appropriate approvals<br>• Use habitat clearing windows and / or obtain permits or regulatory approval, to avoid the removal of nests<br>• Cover and / or re-slope potential Bank Swallow nesting habitat within the PA before the breeding season<br>• Comply with the requirements of the MBCA and Migratory Birds Regulations, if migratory SAR birds are encountered during Project activities. |

Notes:
Con: Construction; Op: Operations; Cl: Closure
● : applicable mitigation to phase
- : not applicable to phase

## 9.7 Assessment of Residual Effects

### 9.7.1 Change in the Abundance of Habitat

Migratory bird habitats within the PA are expected to be directly affected during construction from site preparation and related activities. For assessment purposes, it is assumed that all habitats within the PA will be removed during the construction phase, and rehabilitation will not occur until the closure phase.

This criterion quantifies the direct loss of habitat and the resulting change in its relative abundance, which reflects the availability of key resources (e.g., food and shelter) that influence presence and habitat suitability. Habitats are expected to return during the closure phase, which is considered qualitatively. Mitigation to reduce effects on habitats is already included in the Project footprint, as a compact footprint is proposed.

A residual effect on change in abundance of habitat is anticipated, as discussed below.

#### 9.7.1.1 Construction Phase

The HSMs identified that no migratory bird would lose more than 2% of their habitat in the RSA (Table 9.7-1). The BAM and FRI HSMs identified most of the habitat within the RSA as suitable for many birds. As a result, despite habitat reductions during construction for some birds, the overall change in habitat is small relative to the amount of available habitat in the RSA (Table 9.7-1). Given the large amount of available habitat, the reduction of habitat abundance in the PA was not found to be statistically different than simulated habitat reduction for most birds (all but one p-values > 0.68; Table 9.7-1). The exception was the deciduous forest species, Black-and-white Warbler. This was likely partially due to the coarse scale of the BAM for this species; the BAM identified all habitats within the PA as suitable, even though only approximately 20% of the PA consisted of upland deciduous forests. Despite this difference, the overall impact on Black-and-white Warbler habitat will be less than 2% of the available habitat. As such, alternate deciduous habitat will be available within the RSA.

Significant wildlife habitat will also be impacted by the construction in the PA. For candidate breeding habitat, the reduction is much less than 1% of the available habitat in the RSA. Larger losses will occur to confirmed waterfowl habitat (Table 9.7-2); however, as habitat is more likely to be confirmed in the vicinity of the Project, these values should be treated with caution.

#### 9.7.1.2 Operations Phase

As noted above, all quantitative effects on the relative abundance of habitat are expected from vegetation removal in the PA during the construction phase, and none are expected during the operations phase.

#### 9.7.1.3 Closure Phase

A positive effect is expected in the closure phase as revegetation and succession of naturally occurring vegetation is initiated. The closure phase will directly increase functional habitat.

### 9.7.2 Change in Connectivity and Quality of Habitat

Changes in habitat connectivity will primarily result from habitat removal during the construction phase. Changes in habitat quality may occur at the LSA scale due to groundwater drawdown, noise, dust deposition (i.e., changes in air quality), and alterations in artificial light during construction and operation. Mitigation measures will be implemented to minimize potential impacts on the connectivity and quality of migratory bird habitat. The recommended mitigation measures to address potential effects are provided in Section 9.6. Adaptive management and monitoring will be employed to assess the effectiveness of mitigation measures.

A residual effect on change in connectivity and quality of habitat is anticipated. The species with the largest change is Black-and-white Warbler (potential reasons for this are related to coarse-scale mapping available, discussed in Section 9.7.1).

#### 9.7.2.1 Construction Phase

The construction phase will introduce a variety of pathways that may affect habitat quality. Habitat may be fragmented due to vegetation removal (change in connectivity), and indirect effects from construction activities may reduce the effective habitat available to wildlife.

##### 9.7.2.1.1 Habitat Fragmentation

Landscape fragmentation can reduce the probability that some wildlife species can persist on a landscape (Haddad et al. 2015), particularly species that are sensitive to disturbance and / or require large tracts of habitat to persist (e.g., Black-and-white Warbler and Winter Wren; Lindsay and Collins 1992). With the development of non-vegetated areas adjacent to some habitats, it is predicted that fragmentation will occur along the edges of the PA. Fragmentation will result in changes to the microclimate, creating edge effects that can lower the breeding success of some species (Flaspohler et al. 2001) but that also favour the regrowth of early successional habitat and species adapted to disturbance conditions (e.g., Mourning Warbler).

The results of fragmentation calculations and simulations are presented in Table 9.7-4 (splitting index). The fragmentation statistics for bird species with BAM should be treated with caution due to the coarse spatial scale of the habitat models. For all but one bird species (Black-and-white Warbler), habitat fragmentation from PA impact did not differ statistically from simulations (all $p > 0.532$; Table 9.7-4). Potential reasons for this difference are discussed in Section 9.7.1. Examination of FRI-derived patch sizes for forest and marsh habitats suggests that the PA is already fragmented; across all habitat types, average patch sizes and effective mesh sizes are smaller in the PA than in the RSA (Table 9.4-1). This existing fragmentation reflects early successional habitat in the PA. As such, although minimal fragmentation will occur during construction and operation, post-closure rehabilitation will return habitat to its current state. Given the fragmented nature of much of the PA habitat and the mitigations described in Section 9.6, residual effects to migratory birds from additional fragmentation are not expected.

##### 9.7.2.1.2 Air Quality

Indirect habitat alteration at the LSA scale may result from activities within the PA, such as dust deposition. Dust from operations has the potential to deposit particulate matter, which may negatively impact vegetation communities and bird habitats (e.g., for nesting birds; Farmer 1993; Moudrý et al. 2021). The unmitigated 50% air quality contour for fugitive dust with a suspended particulate matter value of 60 $\mu g/m^3$ was used to estimate worst case indirect effects. The 100% isopleth with a value of 120 $\mu g/m^3$ was not used because it was almost entirely contained within the Project lease boundary and would therefore contribute minimal additional indirect effects to bird habitat.

Even using the expanded dust isopleth, changes in habitat quality due to dust will mostly affect the PA, where direct habitat loss will occur. As such, the indirect effects of air quality are not expected to have an outsized impact on migratory birds. Without mitigation, Project-related habitat changes during construction are 4.5% or less in the LSA and less than 1.5% of the RSA. The species with the largest changes is, again, Black-and-white Warbler (potential reasons for this are discussed in Section 9.7.1). With mitigation to minimize potential impacts and prevent exceedances of air quality guidelines, no residual effects from air quality changes are expected on migratory birds.

##### 9.7.2.1.3 Noise

Sensory disturbance may reduce the quality and function of migratory bird habitat. Intermittent and unpredictable human-caused noise may be perceived as a threat (Frid and Dill 2002; Francis and Barber 2013). In contrast, chronic and frequent noise interferes with a bird's ability to detect important sounds. Acoustic masking from increased noise can interfere with bird communication, particularly at lower frequencies and during the breeding period. Although birds can increase the amplitude of their vocalizations in response to increased ambient noise, habitat avoidance may be a more common response (McClure et al. 2013). This can reduce habitat function and result in locally reduced species richness, diversity and / or abundance (Rheindt 2003; Wood and Yezerinac 2006).

Given that human-caused noise may reduce habitat quality and discourage the use of affected areas, mitigation measures will aim to minimize sensory disturbance. Implementing buffers may be sufficient to mitigate acoustic effects on waterbirds and waterfowl nesting directly adjacent to the PA (Rodgers and Schwikert 2002).

The extent of noise disturbance was modelled given the potential impact of increased noise on migratory bird habitat. The sound threshold for interference with sensitive bird species is 50 to 60 dBA as a one-hour average (Dooling and Popper 2007). As such, noise effects were modelled by creating an area of impact in which noise thresholds may exceed 40 dBA (spatially larger than 60 dBA). Based on this scenario, without mitigation, the largest Project-related habitat changes during construction are for Black-and-white Warbler (potential reasons for this are discussed in Section 9.7.1), with 14.3% in the LSA and 4.76% of the RSA (Table 9.7-6). As these effects are overestimated and mitigation aims to minimize potential impacts, no residual effects from increases in noise are expected on migratory birds.

#### 9.7.2.2 Operations Phase

During the operations phase, habitats within and adjacent to the PA may continue to experience indirect effects that alter quality, particularly from groundwater drawdown, noise, and changes in air quality. Potential indirect effects from light and water quality will be greatest during operations.

##### 9.7.2.2.1 Groundwater Drawdown

Alterations to the groundwater and surface water regimes in wet habitats could have local effects on the form and function of migratory bird habitat. Controlled dewatering and water management activities can affect habitat suitability and configuration by altering the abundance and composition of wetland vegetation that supports nests or serves as food, or by changing the characteristics of the habitat (e.g., from swamp to forest). These changes have the potential to impact species that rely on wetland habitats such as marsh and shorebirds.

Groundwater drawdown will be primarily restricted to the PA (Figure 9.2-2); therefore, the construction of the Project will directly remove most of the habitat that could be affected by groundwater drawdown. In keeping with the conservative assumptions used in the assessment of potential effects, the groundwater drawdown is evaluated to understand the residual effects of the Project on migratory bird habitat. A comparison of the 1 m groundwater drawdown area with suitable habitat for migratory birds found that the area impacted ranged from 0.05 to 0.14% for the birds most likely to be affected (shore and marsh birds; Table 9.7-5). Beyond shore and marsh birds, the largest impact was 0.17% on Black-and-white Warbler habitat. Overall, given the amount of habitat within the RSA for most species, a relatively small proportion of habitat will be affected (Table 9.7-5). Further, the worst case groundwater drawdown is unlikely to occur, and mitigation measures will be implemented to minimize potential impacts. No residual effect from groundwater drawdowns is expected on migratory birds.

##### 9.7.2.2.2 Air Quality

Similar to the construction phase above, without mitigation, Project-related habitat changes are only marginally larger during operation; 3.6% or lower in the LSA and 1.19% or lower in the RSA (Table 9.7-5). The application of dust mitigation measures should result in no residual effects to migratory birds from changes in air quality, since the amount of migratory bird habitat affected by dust will be minimal under the worst case scenario.

##### 9.7.2.2.3 Noise

The largest noise impacts will occur during the operation phase. The largest impact will be on Black-and-white Warbler habitat (15.9% within the LSA and 5.28% within the RSA). The impact on all other species' habitat will be below 5% in the RSA (Table 9.7-6). With the implementation of noise mitigation, sensory disturbances from changes in sound levels are likely to have only a low residual effect on migratory birds, as the quality of wildlife habitat in the LSA is expected to change.

##### 9.7.2.2.4 Artificial Lighting

Migratory birds may avoid habitat areas with artificial lighting. Such avoidance may indicate a real or perceived reduction in habitat quality (Gilroy and Sutherland 2007; Adams et al. 2021; Adams et al. 2024). Disturbance from artificial lighting will largely be constrained to the PA. As such, any habitat that may be avoided due to changes in artificial lighting is already accounted for by direct habitat loss in the PA (Section 9.7.1) and by indirect effects with larger zones of influence (e.g., noise and dust).

With the implementation of artificial light mitigation, sensory disturbances from changes in light levels are likely to have no additional residual effect on migratory birds. Residual effects of artificial lighting on habitat quality are not carried forward into significance determinations. Artificial lighting may increase mortality risks for migratory birds as discussed in Section 9.7.4.

#### 9.7.2.3 Closure Phase

As stated in Section 9.2.4, no closure phase ZOI for air quality or groundwater drawdown was completed. There will be no additional sources of air-emission parameters beyond those assessed during construction and operations. Hydrological conditions, including groundwater levels and surface water flows, are anticipated to gradually return to baseline once final closure conditions are achieved. Closure activities will support the recovery of wetland habitats and improve ecological connectivity across the landscape. Rehabilitated areas may reconnect previously fragmented patches, enhancing connectivity.

Although the 40 dBA noise level exceeded the PA during closure (Figure 9.2-2; Table 9.7-6), these impacts will be much smaller than during operation or construction and will extend minimally beyond the PA. As such, most birds that were disturbed by noise will have already been disturbed during continued operation. During closure, impacts to habitat quality from noise will decrease, and birds will begin to reoccupy the reclaimed site (Lindenmayer et al. 2016).

### 9.7.3 Change in Density and Population

There will be pathways to both direct and indirect effects to density and population from Project construction and operation (Table 9.7-7 to Table 9.7-10). Changes in population and density are inter-related; when a percentage of the population is displaced by direct or indirect effects, the density in the surrounding area will increase accordingly. Although changes in population will predict changes in density, both the affected population percentage and the related density increase in birds/ha are presented. Changes to population and density from direct effects are presented in Table 9.7-7. Changes to population and density from indirect effects are presented separately in Table 9.7-8 (percentage of population affected), and Table 9.7-9 and Table 9.7-10 (changes in density). Herein, population refers to the estimated local population of migratory birds within the RSA.

The largest changes to the density and population of migratory birds will occur in the PA during the construction phase. The operations phase could result in minor additional changes to the habitat that could influence bird densities. During the initial stages of the closure phase, brief periods may occur when work is necessary to remove bird habitat. This could temporarily decrease bird densities. By the end of the closure phase, bird density in the PA is likely to increase due to habitat restoration. Mitigation measures will be implemented to minimize the impact of the Project on migratory bird density and population resulting from the pathways described in Section 9.5.

#### 9.7.3.1 Construction Phase

To assess changes to bird populations and density, it has been conservatively assumed that all individuals within the PA will be impacted. This is an overestimation because not all habitats in the PA will be disturbed, nor will all individuals that use those habitats be disturbed. The birds within the PA will likely move to the LSA and RSA in response to the Project. The immediate effect of this will be an increase in conspecific competition in the LSA, which may reduce the breeding success of some individuals (Hagan et al. 1996). This effect is likely to be temporary, as birds disperse further from the PA into the RSA (Coldren 1998). The extent to which local populations can adjust to these changes will depend on the number of individuals displaced by the PA.

On average, across proxy species, 1.37% of the population within the RSA will be impacted by the removal of the PA. The removal of the PA will have the largest impact on Mourning Warbler, with 1.94% of the population in the RSA affected, and the least impact on Swamp Sparrow, with 0.29% of the population in the RSA affected (Table 9.7-7). A larger impact on Mourning Warbler likely reflects the early-successional nature of the habitat within the PA. Assuming all impacted birds remain within the RSA, and there is sufficient suitable habitat outside the PA, the largest increase in bird density would be a gain of 0.0045 birds/ha for Mallard (Table 9.7-7), with an average gain of 0.0016 birds/ha across all migratory bird proxy species. Overall, the number of migratory birds in the PA constitutes a small percentage of their respective populations within the RSA. As such, any changes to overall bird populations within the RSA are expected to be small.

#### 9.7.3.2 Construction Phase and Operations Phase

Indirect effects may also impact bird populations. It is unlikely that all birds will move from areas of indirect disturbance, and the largest indirect disturbances will be contained within the PA. Worst case scenario impacts assume that all migratory birds are equally affected by noise, dust, and water drawdown and are presented in Table 9.7-8 to Table 9.7-10. The largest indirect effect on density will occur from noise during operations (Table 9.7-10). Assuming all migratory birds leave the affected ZOI and remain in the LSA, the largest increase in density would occur for Mallard; an increase by 0.0764 birds/ha (Table 9.7-10). Due to the larger size of the RSA, increases in density in the RSA will be smaller than the LSA values presented.

#### 9.7.3.3 Closure Phase

Although migratory bird populations within the RSA will likely adapt to changes in density during construction and operation, there will be a temporary change in the ecological bird community within the PA post-closure. Post-closure, there may be a positive effect on the populations of bird species that thrive in disturbed and early successional habitats, such as Mourning Warbler. In contrast, species that require mature forests, such as the Black-and-white Warbler, are likely to return with increased mature forest cover (Nichols and Grant 2007; Lindenmayer et al. 2016). Over time, the affected bird species will return to the reclaimed PA (Nichols and Grant 2007); thus, no residual effects from changes in bird densities and populations are expected. Changes in lighting will primarily be contained within the PA and are discussed under change in risk of mortality (Section 9.7.4).

### 9.7.4 Change in Risk of Mortality

Mitigation measures will be applied to potential effect pathways (Section 9.6) to minimize mortality risks to migratory birds. The largest risk of mortality, vegetation clearing within sensitive timing windows, will be avoided by clearing outside those windows. The identified pathways highlight a number of risks to mortality; infrastructure, artificial lighting, machinery, vehicles, and buildings all pose risks to birds. Risks from human infrastructure include both direct collisions and the attraction of nest predators, such as corvids (Bishop and Brogan 2013; Machtans et al. 2013). Habitat loss and increased noise and disturbance from daily operations will likely deter birds particularly during the construction phase and operation phase (McClure et al. 2013), reducing the likelihood of fatal interactions within the PA.

Artificial lighting can increase mortality among nocturnally migrating birds, such as warblers and sparrows. Artificial lighting at night can attract and disorient birds, trapping them within the lighting zone and increasing their mortality risk (Adams et al. 2021). The risk for this will be greatest during the operation phase, when artificial lighting use will be mostly continuous. Overall, mitigation measures such as downcast lights, using shielding to minimize light spill, and maintaining light sources below barriers will reduce the effects of artificial light on the risk of mortality for migratory birds. When downward-facing lighting is not possible, research suggests that warmer, longer-wavelength light may reduce attraction (Zhao et al. 2020); however, red light is not recommended (Poot et al. 2008) which will be avoided by the Project as reasonable. In cases where lighting is required on buildings due to height, flashing lights can mitigate potential effects (Gehring et al. 2009) and will be considered.

The impact of any residual mortality risk on a migratory bird species is intrinsically tied to that species' density and population because additional bird mortalities will likely be compensated for through natural processes (Sinclair and Pech 1996; Boyce et al. 1999). For example, the loss of some individuals within a population can decrease competition for limited resources and increase population growth (i.e., negative density dependence; Rose et al. 2001). This process, in which lower-density populations can compensate by growing faster, has been documented in birds (Paradis et al. 2002). This type of compensation should occur as long as a population does not fall below a threshold at which individuals cannot find mates or engage in necessary social interactions (Stephens and Sutherland 1999; Kramer et al. 2009). Among the proxy species, density models suggest reasonable populations within the RSA that should buffer any residual increase in mortality (Table 9.7-3).

For Lesser Yellowlegs, only two individuals were detected by ARUs in the PA, and the baseline point count surveys did not detect any individuals in the PA (Appendix M-2). Due to the scarcity of Lesser Yellowlegs, there should be no change in mortality risk for this species. If individuals are present in the impacted areas, they should be able to relocate without encountering additional conspecific competition due to the low densities within the RSA (Table 9.7-3).

In summary, human activity within the PA will increase mortality risks and the risk of mortality cannot be eliminated during construction and operations.

### 9.7.5 Change to Migratory Bird SAR

The construction, operations, and closure phases of the Project have pathways that can affect migratory bird SAR, with the greatest potential for impact during the operations phase. The effects on migratory SAR birds are the same as the effects on the proxy species discussed in the sections above (Section 9.7.1 to Section 9.7.4). The pathways to effects from changes in abundance of habitat, connectivity and quality of habitat, density and population, and risk of mortality that are specific to migratory bird SAR are discussed in this section. Mitigation measures will be applied to potential effect pathways (Section 9.6) to minimize impacts to SAR birds.

#### 9.7.5.1 Abundance of Habitat

Potential effects are discussed in Section 9.7.1 and are also relevant to migratory SAR birds. Like migratory bird habitat, the loss of migratory bird SAR habitat is expected to be greatest during the construction phase of the Project. Despite habitat reduction during construction, the overall change in habitat will be small relative to the amount of available habitat in the RSA. The average change to migratory SAR bird habitat will be 1.28%, and simulations identified no outsized impacts relative to available habitat in the Project vicinity (all $p > 0.066$; Table 9.7-11). The largest loss of habitat will be for Eastern Wood-pewee at 2.12%. This is likely because these birds prefer mixed forest and edge habitat, which is present in much of the PA (Section 7.8).

Notably, two Bank Swallow colonies are present within the PA. Using appropriate timing windows for habitat removal will minimize effects on the birds that use these colonies. Although no habitat mapping was available for Bank or Barn Swallow, BAM density maps suggest that these birds use habitat within the RSA, and both Riparian (Bank Swallow) and anthropogenic habitat (Barn Swallow) occur within the RSA (Section 7.8). As such, alternative habitat is available. In contrast to concerns over lost habitat, a potential concern for these two species is the creation of suitable nesting habitat. As Barn Swallows will nest in anthropogenic structures and Bank Swallows will nest in open pits (MECP 2022, 2023), this risk is proposed to be mitigated for the Project through consistent monitoring and implementation of measures such as regrading slopes and employee education (Section 9.6).

Overall, with the implementation of mitigation measures and the small amount of habitat lost in relation to what is available, the Project is expected to have no residual effects on migratory bird SAR due to changes in habitat abundance.

#### 9.7.5.2 Connectivity and Quality of Habitat

Potential effects are discussed in Section 9.7.2 and are also relevant to migratory SAR birds. Potential effects on habitat connectivity and quality are assessed by examining the impact of the Project on habitat fragmentation and by determining the percentage of habitat indirectly altered by groundwater drawdown, changes in air quality and sound. These habitat changes can alter the suitability of habitats.

##### 9.7.5.2.1 Habitat Fragmentation

Fragmentation calculations and simulations results for SAR are presented in Table 9.7-12. For all migratory bird SAR, habitat fragmentation from PA impact did not differ statistically from simulations (all $p > 0.264$; Table 9.7-12). Given the relatively high levels of fragmentation currently within the PA, and the mitigations described in Section 9.6, residual effects to migratory bird SAR from additional fragmentation are not expected.

##### 9.7.5.2.2 Groundwater Drawdown

Potential groundwater drawdown effects will mostly occur during the operations phase and will primarily affect the PA where most of the habitat that could be affected will have been removed. A comparison of the 1 m groundwater drawdown zone with suitable habitat for migratory birds, specifically the SAR, found that the area impacted was only 0.04% for the bird most likely to be affected (Yellow Rail; Table 9.7-13). The largest impact was 0.17% on Canada Warbler habitat. Overall, given the amount of habitat within the RSA for most migratory SAR species, a relatively small proportion of habitat will be affected (Table 9.7-13). During the closure phase, the PA will be rehabilitated, resulting in a return to near-baseline groundwater conditions once dewatering activities cease. Groundwater drawdown is unlikely to contribute to residual effects on the connectivity and quality of migratory bird habitats.

##### 9.7.5.2.3 Air Quality

Changes in habitat quality due to dust will primarily affect the PA, where direct habitat loss is expected to occur. As such, the indirect effects of air quality are not expected to have an outsized impact on migratory bird SAR. Even without mitigation, Project-related changes range from 0.55% of Yellow Rail habitat to 2.49% of Canada Warbler habitat within the RSA during construction. Similar, non-additive impacts will occur during operation (Table 9.7-13). Given that the amount of migratory bird habitat affected by dust will be minimal under the worst case scenario, the application of dust mitigation measures should result in no residual effects to migratory bird SAR from changes in air quality.

##### 9.7.5.2.4 Noise

Based on worst case scenarios that do not account for all mitigation measures and assume continuous noise effects, the largest noise impacts are expected to occur during the operations phase. Anticipated impacts from noise on each species' habitat are found in Table 9.7-14. For all but two migratory bird SAR, the percentage of impacted habitat by noise will be less than 5% of the available habitat. For Canada Warbler and Eastern Wood-pewee, the percentages of impacted habitat will be 7.79% and 5.26%, respectively. Although Project-related noise will occur during the closure phase, these impacts will be much smaller than during the construction phase or operations phase, and extend minimally beyond the PA (Table 9.7-14). As such, most birds that were disturbed by noise will have already been disturbed during continued operation. During closure, impacts on habitat quality from noise will decrease, and birds will begin to reoccupy the reclaimed site (Lindenmayer et al. 2016).

Noise mitigation will reduce these potential impacts to levels below the worst case scenario for migratory bird SAR. With the implementation of noise mitigation, sensory disturbances from changes in sound levels are likely to have only a small effect on migratory bird SAR, as the quality of wildlife habitat in the LSA is expected to remain unchanged. As habitat is relatively abundant within the RSA (Table 9.7-11) and estimated densities are low (Table 9.7-15), relocation due to disturbance should be possible with minimal conspecific competition. As such, no residual effects due to noise exceedances are expected for migratory bird SAR.

##### 9.7.5.2.5 Artificial Lighting

The construction, operation, and closure phases of the Project will require the use of artificial lighting. Artificial lighting may affect crepuscular / nocturnal Common Nighthawk and Eastern Whip-poor-will. These potential effects are discussed under Risks to Mortality for migratory bird SAR.

#### 9.7.5.3 Change in Density and Population

Potential effects are discussed in Section 9.7.3 and are also relevant to migratory SAR birds. In contrast to the proxy migratory bird species discussed in Section 9.7.3, the densities of migratory bird SAR are more than 10x lower (Table 9.7-3). As the existing density of migratory bird SAR is low, an increase in density above baseline is unlikely to significantly increase conspecific competition. Low population density can result in demographic Allee effects in which individuals have trouble finding mates and / or exploiting social cues (Stephens and Sutherland 1999). As such, for species with low densities, increases in the RSA may be useful.

The removal of the PA will have the largest change on Canada Warbler, with 1.53% of the population in the RSA affected, and the least amount of change on Olive-sided Flycatcher, with 0.76% of the population in the RSA affected (Table 9.7-16). Assuming all displaced birds remain within the RSA, the largest increase in bird density would be 0.0003 birds/ha for Canada Warbler and Evening Grosbeak (Table 9.7-16).

Mitigated indirect disturbances will be largely contained within the PA. Nevertheless, ZOIs were assessed assuming worst case indirect effect scenarios. The largest indirect effect on migratory SAR bird populations within the RSA is expected to occur from noise generated during the operations phase. The percentage of migratory SAR bird populations within the RSA affected by noise will range from 2.99 to 4.39% (Table 9.7-17). Assuming all migratory bird SAR leave the ZOIs but remain in the LSA, the largest density increase in the LSA would occur for Evening Grosbeak with a maximum increase of 0.0046 birds/ha (Table 9.7-18 and Table 9.7-19). During closure, there may be an increase in the density of migratory bird SAR that thrive in early successional habitats, such as Common Nighthawk. Changes in lighting will primarily be contained within the PA and may affect crepuscular / nocturnal SAR; this is discussed under the change in risk of mortality.

Overall, just as in Section 9.7.3, the number of SAR birds within the PA constitutes a small percentage of its respective population within the RSA. As such, any changes to overall bird populations within the RSA are expected to be small. SAR migratory birds have comparatively (to proxy species) low densities within the LSA and RSA, and it is unlikely that any small increase, whether direct or indirect, will negatively impact these species during any phase. Instead, density increase may increase reproductive output in some species with small populations (Courchamp et al. 2008). No residual effects on migratory bird SAR are expected from changes to density or population.

#### 9.7.5.4 Change in Risk of Mortality

Potential effects are discussed in Section 9.7.4 and are also relevant to migratory SAR birds. Additional considerations for SAR include the risk posed by increased road traffic and artificial lighting to crepuscular / nocturnal nightjars. These birds have been found to frequent roads for foraging or thermal regulation. A recent study however, found that the increased mortality risk was small in the Canadian boreal forests and unlikely to be a conservation concern (Foley and Brigham 2025). Nightjars may also be drawn to artificial light by aggregating prey (i.e., insects; Foley and Wszola 2017), and there is some evidence that artificial lighting can improve nightjar foraging success (Adams et al. 2024; Creemers et al. 2025). Despite potential benefits, increased illumination may increase nest predation risk (Adams et al. 2024). For these birds, mitigations such as reduced speed limits, light shielding, and directed lighting sources will be important. These measures should mitigate most risks specific to their ecology. For the other migratory bird SAR, the loss of habitat and increased noise and disturbance during construction and operation will likely act as a deterrent to birds (McClure et al. 2013), reducing the likelihood of Project-related mortalities.

The impact of any residual mortality risk on any migratory bird species is intrinsically tied to its density and overall population. Above a critical density threshold, additional bird mortalities will likely be compensated for through natural processes, as discussed in Section 9.7.4 (Sinclair and Pech 1996; Stephens and Sutherland 1999; Boyce et al. 1999). For migratory SAR birds, low densities mean that populations may not compensate for mortality as easily (Stephens and Sutherland 1999; Courchamp et al. 2008; Kramer et al. 2009). However, densities may also increase in the vicinity of the PA as birds leave disturbed areas. If this increases densities above a critical threshold, bird populations could more easily compensate for any losses (Kuparinen 2017). In summary, the risk of mortality cannot be eliminated, but planned mitigations will offset risk. There may be a small residual effect on migratory bird SAR due to their low population densities.

**Table 9.7-1: Habitat Abundance in PA and Change in Abundance after PA Removal for Assessed Migratory Birds**

| Species | Preferred Habitat | Model Type | Habitat in PA (ha) | % of PA that is Habitat | Habitat in RSA (ha) | % Habitat Change (Actual) | Mean Simulated Habitat Change | P value |
|---|---|---|---|---|---|---|---|---|
| Yellow-rumped Warbler | Coniferous forests | BAM | 3,349.22 | 100 | 251,328.56 | -1.33 | -1.33 | 1 |
| Black-and-White Warbler | Deciduous forests | BAM | 3,349.22 | 100 | 175,655.21 | -1.91 | -1.10 | 0.032 |
| Winter Wren | Mixed forests | BAM | 3,349.22 | 100 | 251,328.56 | -1.33 | -1.33 | 1 |
| Lesser Yellowlegs | Shores | FRI | 964.52 | 28.8 | 95,356.24 | -1.01 | -1.67 | 0.982 |
| Wilson's Snipe | Shores | FRI | 749.70 | 22.38 | 74,760.83 | -1.00 | -1.60 | 0.974 |
| Mallard | Waterfowl | FRI | 98 | 3.93 | 44,460.09 | -0.22 | -0.26 | 0.682 |
| Common Loon | Waterbird | FRI | 0 | 0 | 29,574.08 | -0.00 | -0.02 | 1 |
| Swamp Sparrow | Marshes | BAM | 3,349.22 | 100 | 244,388.52 | -1.37 | -1.37 | 1 |
| Mourning Warbler | Early successional | BAM | 3,349.22 | 100 | 247,064.61 | -1.36 | -1.36 | 0.988 |

Notes:
Percentages were calculated as ((observed value – baseline value) / baseline value) * 100.

**Table 9.7-2: Change in Abundance of Significant Wildlife Habitat for Migratory Birds**

| Species | Habitat in RSA (ha) | Habitat in LSA (ha) | Habitat in PA (ha) | % Habitat in PA [(1)] | % Habitat in LSA [(1)] |
|---|---|---|---|---|---|
| Candidate Marsh Breeding Bird Habitat | 17,354.19 | 4,779.59 | 128.18 | 0.74 | 27.52 |
| Confirmed Marsh Bird Breeding | 26.51 | 26.51 | 0 | 0 | 100 |
| Candidate Waterfowl Stopover and Staging Areas: Aquatic | 858.14 | 285.39 | 0 | 0 | 33.26 |
| Confirmed Waterfowl Stopover and Staging Areas: Aquatic | 232.12 | 232.12 | 10.14 | 4.37 | 100 |
| Candidate Waterfowl Nesting Areas | 6,267.48 | 2,419.51 | 59.27 | 0.95 | 38.60 |
| Confirmed Waterfowl Nesting Areas | 1,461 | 1,413.25 | 252.35 | 17.27 | 96.73 |
| Candidate Colonially Nesting Bird Breeding Habitat: Tree / shrub | 0.04 | 0.03 | 0 | 0 | 75 |
| Confirmed Colonially Nesting Bird Breeding Habitat: Tree / shrub | 18.13 | 18.13 | 0 | 0 | 100 |

Notes:
1. (Habitat in PA or LSA / total available habitat in RSA) * 100

**Table 9.7-3: Bird Density in PA, LSA and RSA for select Migratory Birds Species**

| Species | Preferred Habitat | Model Type | Density PA (birds / ha) | Density LSA (birds / ha) | Density in RSA (birds / ha) |
|---|---|---|---|---|---|
| Yellow-rumped Warbler | Coniferous forests | GLM | 0.18 | 0.15 | 0.15 |
| Black-and-White Warbler | Deciduous forests | GLM | 0.07 | 0.06 | 0.05 |
| Winter Wren | Mixed forests | GLM | 0.10 | 0.09 | 0.12 |
| Lesser Yellowlegs | Shores | BAM | <0.01 (1) | <0.01 (1) | <0.01 (1) |
| Wilson's Snipe | Shores | BAM | 0.01 | 0.01 | 0.01 |
| Mallard | Waterfowl | GLM | 0.34 | 0.34 | 0.34 |
| Common Loon | Waterbird | GLM | 0.04 | 0.04 | 0.04 |
| Swamp Sparrow | Marshes | GLM | 0.06 | 0.26 | 0.28 |
| Mourning Warbler | Early successional | GLM | 0.19 | 0.15 | 0.13 |

Note:
GLM use an offset to account for imperfect detection (Appendix M-2)
1. Calculated density: 0.00006

**Table 9.7-4: Habitat Fragmentation from PA Impact for Migratory Birds**

| Species | Preferred Habitat | Model Type | Baseline Splitting Index (1) | Splitting Index after PA Impact | % Change (Actual) (2) | Mean Simulated (3) % Change | P value (4) |
|---|---|---|---|---|---|---|---|
| Yellow-rumped Warbler | Coniferous forests | BAM | 1.00 | 1.03 | 2.72 | 2.72 | 1 |
| Black-and-White Warbler | Deciduous forests | BAM | 1.37 | 1.43 | 4.55 | 2.59 | 0.034 |
| Winter Wren | Mixed forests | BAM | 1.00 | 1.03 | 2.72 | 2.72 | 1 |
| Lesser Yellowlegs | Shores | FRI | 25.94 | 25.96 | 0.07 | 4.06 | 0.996 |
| Wilson's Snipe | Shores | FRI | 7,227.65 | 7,293.89 | 0.92 | 1.41 | 0.850 |
| Mallard | Waterfowl | BAM | 15.73 | 15.73 | 0 | 0.01 | 1 |
| Common Loon | Waterbird | BAM | 5.13 | 5.13 | 0 | 0.01 | 1 |
| Swamp Sparrow | Marshes | BAM | 1.08 | 1.11 | 2.91 | 2.91 | 1 |
| Mourning Warbler | Early successional | BAM | 1 | 1.03 | 2.77 | 2.77 | 0.988 |

Notes:

1. Splitting Index represents the number of equal sized patches that would produce the observed fragmentation (Jaegar 2000). Large numbers indicate more fragmentation. Baseline splitting index will be partially contingent on the scale at which the habitat model was produced and is informative.
2. Calculated as (Splitting index after direct impacts – Baseline splitting index) / Baseline splitting index
3. Simulations involve creating a distribution of potential fragmentation impacts in the area surrounding the Project vicinity.
4. Low p-values indicate that the potential impact is outsized compared to simulated impacts on available habitat in the Project vicinity.

### Table 9.7-5: Summary of Indirect Effects from Groundwater and Air on Migratory Bird Proxy Species in LSA and RSA

| Species | LSA Habitat | | Operations Groundwater Drawdown (1) | | | Construction Particulate Matter (Air) (2) | | | Operations Particulate Matter (Air) (2) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Habitat in LSA | % of total habitat in LSA | Effect Area | LSA % Change (3) | RSA % Change (3) | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change |
| Yellow-rumped Warbler | 69,198.27 | 27.41 | 296.57 | -0.43% | -0.12% | 2,614.36 | -3.8% | -1.04% | 2,099.06 | -3.03% | -0.84% |
| Black-and-white Warbler | 58,264.83 | 33.03 | 296.57 | -0.51% | -0.17% | 2,614.36 | -4.5% | -1.49% | 2,099.06 | -3.60% | -1.19% |
| Winter Wren | 69,198.27 | 27.41 | 296.57 | -0.43% | -0.12% | 2,614.36 | -3.8% | -1.04% | 2,099.06 | -3.03% | -0.84% |
| Lesser Yellowlegs | 18,557.27 | 19.46 | 133.45 | -0.72% | -0.14% | 760.64 | -4.1% | -0.80% | 508.57 | -2.74% | -0.53% |
| Wilson's Snipe | 19,945.52 | 26.68 | 35.8 | -0.18% | -0.05% | 605.45 | -3.0% | -0.81% | 388.72 | -1.95% | -0.52% |
| Mallard | 19,417.93 | 39.51 | 6.82 | -0.04% | -0.01% | 280.21 | -1.4% | -0.57% | 120.45 | -0.62% | -0.25% |
| Common Loon | 16,839.12 | 36.02 | 8.5 | -0.05% | -0.02% | 211.15 | -1.3% | -0.45% | 61.09 | -0.36% | -0.13% |
| Swamp Sparrow | 69,198.27 | 28.19 | 296.57 | -0.43% | -0.12% | 2,614.36 | -3.8% | -1.07% | 2,099.06 | -3.03% | -0.86% |
| Mourning Warbler | 65,835.01 | 26.53 | 296.57 | -0.45% | -0.12% | 2,614.36 | -4.0% | -1.06% | 2,099.06 | -3.19% | -0.85% |

Notes:
1. 1 m drawdown.
2. 50% contour for a suspended particulate matter value of 60 ug/m$^3$.
3. Percentage additional change in species habitat is calculated as = (Species Habitat Area in the LSA or RSA Subjected to Indirect Effect During Mine Phase) / (Total Species Habitat Area in the LSA or RSA).

**Table 9.7-6: Summary of Indirect Effect from Noise on Migratory Bird Proxy Species Habitat in LSA and RSA**

| Species | LSA Habitat | | Construction Noise [1] | | | Operation Noise [1] | | | Closure Noise [1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Habitat in LSA | % of total habitat in LSA | Effect Area | LSA % Change [2] | RSA % Change [2] | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change |
| Yellow-rumped Warbler | 69,198.27 | 27.41 | 8,355.51 | -12.1% | -3.32% | 9,486.42 | -13.7% | -3.77% | 66.46 | -0.10% | -0.03% |
| Black-and-white Warbler | 58,264.83 | 33.03 | 8,355.51 | -14.3% | -4.76% | 9,282.84 | -15.9% | -5.28% | 66.46 | -0.11% | -0.04% |
| Winter Wren | 69,198.27 | 27.41 | 8,355.51 | -12.1% | -3.32% | 9,486.42 | -13.7% | -3.77% | 66.46 | -0.10% | -0.03% |
| Lesser Yellowlegs | 18,557.27 | 19.46 | 2,419.37 | -13.0% | -2.54% | 2,702.69 | -14.6% | -2.83% | 12.69 | -0.07% | -0.01% |
| Wilson's Snipe | 19,945.52 | 26.68 | 2,308.85 | -11.6% | -3.09% | 2,702.7 | -13.6% | -3.62% | 21.9 | -0.11% | -0.03% |
| Mallard | 19,417.93 | 39.51 | 1,450.22 | -7.5% | -2.95% | 1,729.59 | -8.9% | -3.52% | 2.47 | -0.01% | -0.01% |
| Common Loon | 16,839.12 | 36.02 | 1,184.28 | -7.0% | -2.53% | 1,458.32 | -8.7% | -3.12% | 3.83 | -0.02% | -0.01% |
| Swamp Sparrow | 69,198.27 | 28.19 | 8,355.51 | -12.1% | -3.42% | 9,486.42 | -13.7% | -3.88% | 66.46 | -0.10% | -0.03% |
| Mourning Warbler | 65,835.01 | 26.53 | 8,355.51 | -12.7% | -3.38% | 9,299.96 | -14.1% | -3.76% | 66.46 | -0.10% | -0.03% |

Notes:
1. 40 dBA daytime noise contour.
2. Percentage additional change in species habitat is calculated as = (Species Habitat Area in the LSA or RSA Subjected to Indirect Effect During Mine Phase) / (Total Species Habitat Area in the LSA or RSA).

### Table 9.7-7: Inferred Population in the RSA and Number of Individuals in the PA for Select Migratory Bird Species

| Species | Preferred Habitat | Inferred Population within PA (1) | Inferred Population within RSA | % of Population Impacted (2) | Increase in Density (birds / ha) (3) |
|---|---|---|---|---|---|
| Yellow-rumped Warbler | Coniferous forests | 619 | 38,866 | 1.59 | 0.0020 |
| Black-and-White Warbler | Deciduous forests | 220 | 13,587 | 1.62 | 0.0007 |
| Winter Wren | Mixed forests | 327 | 27,832 | 1.18 | 0.0015 |
| Lesser Yellowlegs | Shores | 0.22 | 16 | 1.43 | < 0.0001 |
| Wilson's Snipe | Shores | 37 | 2,495 | 1.47 | 0.0001 |
| Mallard | Waterfowl | 1,141.20 | 85,405.97 | 1.34 | 0.0045 |
| Common Loon | Waterbird | 145.55 | 10,209.14 | 1.43 | 0.0005 |
| Swamp Sparrow | Marshes | 204 | 69,925 | 0.29 | 0.0037 |
| Mourning Warbler | Early successional | 626 | 32,273 | 1.94 | 0.0017 |

Notes:
LSA population data is not provided. The TISG defines the LSA as an undefined area beyond the PA. In contrast, the RSA is defined at an ecological scale, which is preferred for defining populations. Changes in density in the LSA are provided in Table 9.7-9 and Table 9.7-10.
1. Using density rasters, populations are inferred by summing the number of individuals predicted in each raster cell.
2. Population in PA / Population in RSA.
3. (Number of inferred individuals in RSA / (Area of RSA – Area of PA)) – (Number of inferred individuals in RSA / Area of RSA).

**Table 9.7-8: Population Impact from Indirect Effects on Select Migratory Bird Species**

| Species | Preferred Habitat | % of impacted population (1) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Operations Groundwater Drawdown (2) | Construction Particulate Matter (air) (3) | Operations Particulate Matter (air) (3) | Construction Noise (4) | Operation Noise (4) | Closure Noise (4) |
| Yellow-rumped Warbler | Coniferous forests | 0.13 | 1.12 | 0.98 | 3.58 | 4.00 | 0.03 |
| Black-and-White Warbler | Deciduous forests | 0.14 | 1.34 | 1.12 | 4.26 | 4.98 | 0.03 |
| Winter Wren | Mixed forests | 0.12 | 0.98 | 0.78 | 2.98 | 3.35 | 0.02 |
| Lesser Yellowlegs | Shores | 0.13 | 1.07 | 0.88 | 3.25 | 3.64 | 0.03 |
| Wilson’s Snipe | Shores | 0.13 | 1.11 | 0.91 | 3.36 | 3.76 | 0.03 |
| Mallard | Waterfowl | 0.12 | 1.03 | 0.83 | 3.36 | 3.84 | 0.03 |
| Common Loon | Waterbird | 0.13 | 1.10 | 0.89 | 3.45 | 3.90 | 0.03 |
| Swamp Sparrow | Marshes | 0.02 | 0.39 | 0.09 | 1.68 | 1.82 | < 0.01 |
| Mourning Warbler | Early successional | 0.17 | 1.58 | 1.37 | 4.78 | 5.53 | 0.04 |

Notes:
1. (Inferred population in impact zone / total inferred population in RSA) * 100.
2. 1 m drawdown.
3. 50% contour for a suspended particulate matter value of 60 µg/m$^3$.
4. 40 dBA daytime noise contour.

**Table 9.7-9: Potential Indirect Effects, Groundwater and Air on Migratory Proxy Species Density in the LSA**

| Species | Baseline | Operations Groundwater Drawdown | | Construction Particulate Matter (Air) | | Operations Particulate Matter (Air) | |
|---|---|---|---|---|---|---|---|
| | Average Density in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) |
| Yellow-rumped Warbler | 0.1504 | 0.1743 | 0.0084 | 0.1721 | 0.0142 | 0.1820 | 0.0128 |
| Black-and-white Warbler | 0.0604 | 0.0656 | 0.0034 | 0.0698 | 0.0057 | 0.0724 | 0.0052 |
| Winter Wren | 0.0932 | 0.1165 | 0.0052 | 0.1048 | 0.0088 | 0.1034 | 0.0080 |
| Lesser Yellowlegs | 0.0001 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0001 | 0.0000 |
| Wilson’s Snipe | 0.0092 | 0.0110 | 0.0005 | 0.0106 | 0.0009 | 0.0108 | 0.0008 |
| Mallard | 0.3356 | 0.3315 | 0.0187 | 0.3363 | 0.0316 | 0.3358 | 0.0287 |
| Common Loon | 0.0386 | 0.0435 | 0.0021 | 0.0429 | 0.0036 | 0.0435 | 0.0033 |
| Swamp Sparrow | 0.2640 | 0.0421 | 0.0147 | 0.1038 | 0.0249 | 0.0290 | 0.0225 |
| Mourning Warbler | 0.1503 | 0.1871 | 0.0084 | 0.1947 | 0.0142 | 0.2111 | 0.0128 |

Notes:
Density increase is calculated as: (Number of inferred individuals in LSA / (Area of LSA – Impacted Area)) – (Number of inferred individuals in LSA / Area of LSA).

**Table 9.7-10: Potential Indirect Effects, Noise, on Migratory Bird Proxy Species Density in the LSA**

| Species | Baseline | Construction Noise | | Operation Noise | | Closure Noise | |
|---|---|---|---|---|---|---|---|
| | Average Density In LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) |
| Yellow-rumped Warbler | 0.1504 | 0.1664 | 0.0306 | 0.1639 | 0.0342 | 0.2033 | 0.0078 |
| Black-and-white Warbler | 0.0604 | 0.0692 | 0.0123 | 0.0714 | 0.0138 | 0.0633 | 0.0031 |
| Winter Wren | 0.0932 | 0.0992 | 0.0190 | 0.0982 | 0.0212 | 0.0860 | 0.0048 |
| Lesser Yellowlegs | 0.0001 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0001 | 0.0000 |
| Wilson's Snipe | 0.0092 | 0.0100 | 0.0019 | 0.0099 | 0.0021 | 0.0110 | 0.0005 |
| Mallard | 0.3356 | 0.3436 | 0.0683 | 0.3459 | 0.0764 | 0.3357 | 0.0174 |
| Common Loon | 0.0386 | 0.0421 | 0.0079 | 0.0420 | 0.0088 | 0.0435 | 0.0020 |
| Swamp Sparrow | 0.2640 | 0.1405 | 0.0537 | 0.1339 | 0.0601 | 0.0130 | 0.0137 |
| Mourning Warbler | 0.1503 | 0.1847 | 0.0306 | 0.1882 | 0.0342 | 0.2060 | 0.0078 |

Notes:
Indirect effects from noise use daytime noise modelling.
Density increase = (Number of inferred individuals in LSA / (Area of LSA – Impacted Area)) – (Number of inferred individuals in LSA / Area of LSA).

**Table 9.7-11: Change in Habitat Abundance for Migratory Bird SAR**

| Species | Preferred Habitat | Model Type | Habitat in PA (ha) | % of PA that is Habitat | Habitat in RSA (ha) | % Habitat Change (Actual) | Mean Simulated Habitat Change | P value |
|---|---|---|---|---|---|---|---|---|
| Canada Warbler | Mixed forests | FRI | 758.77 | 22.66 | 41,446.48 | -1.83 | -1.73 | 0.46 |
| Evening Grosbeak | Coniferous forests | FRI | 2,670.97 | 79.75 | 160,855.99 | -1.67 | -1.54 | 0.368 |
| Eastern Wood-pewee | Mixed forests | FRI | 2,467.12 | 73.66 | 116,452.45 | -2.12 | -1.52 | 0.066 |
| Eastern Whip-poor-will and Common Nighthawk | Early successional | FRI | 687.1 | 20.52 | 30,926.87 | -1.01 | -1.06 | 0.574 |
| Olive-sided Flycatcher | Open coniferous forests | FRI | 628.03 | 18.75 | 61,195.57 | -1.03 | -1.50 | 0.904 |
| Yellow Rail | Marshes | FRI | 16.59 | 0.50 | 5,645.91 | -0.29 | -1.45 | 0.998 |

Notes:
Percentages were calculated as ((observed value – baseline value) / baseline value) * 100.
Barn Swallow and Bank Swallow models were not available (see text for details).

### Table 9.7-12: Habitat Fragmentation from PA Impact for Migratory Bird SAR

| Species | Preferred Habitat | Model Type | Baseline Splitting Index (1) | Splitting Index After PA Impact | % Change (Actual) (2) | Mean Simulated % Change (3) | P value (4) |
|---|---|---|---|---|---|---|---|
| Canada Warbler | Mixed forests | FRI | 180.17 | 187.23 | 3.92 | 2.61 | 0.264 |
| Evening Grosbeak | Coniferous forests | FRI | 8,272.46 | 8,421.72 | 1.80 | 1.53 | 0.31 |
| Eastern Wood-pewee | Mixed forests | FRI | 34.70 | 35.64 | 2.69 | 1.91 | 0.276 |
| Eastern Whip-poor-will and Common Nighthawk | Early successional | FRI | 5.57 | 5.73 | 2.79 | 1.93 | 0.302 |
| Olive-sided Flycatcher | Open coniferous forests | FRI | 83.60 | 83.77 | 0.20 | 1.17 | 0.952 |
| Yellow Rail | Marshes | FRI | 238.15 | 238.54 | 0.17 | 1.45 | 0.884 |

Notes:
Barn Swallow and Bank Swallow models were not available (see text for details).
1. Splitting Index represents the number of equal sized patches that would produce the observed fragmentation (Jaegar 2000). Large numbers indicate more fragmentation. Baseline splitting index will be partially contingent on the scale at which the habitat model was produced. As such, change in splitting index is informative.
2. Calculated as (Splitting index after direct impacts – Baseline splitting index) / Baseline splitting index.
3. Simulations involve creating a distribution of potential fragmentation impacts in the area surrounding the Project vicinity.
4. Low p-values indicate that the potential impact is outsized compared to simulated impacts on available habitat in the Project vicinity.

**Table 9.7-13: Indirect Effects, Groundwater and Air, on Migratory Bird SAR Habitat in the LSA and RSA**

| Species | LSA Habitat | | Operations Groundwater Drawdown | | | Construction Particulate Matter (Air) | | | Operations Particulate Matter (Air) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Habitat in LSA | % of Total Habitat in LSA | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change |
| Canada Warbler | 15,887.19 | 38.33 | 72.13 | -0.45% | -0.17% | 1,033.8 | -6.5% | -2.49% | 924.88 | -5.82% | -2.23% |
| Evening Grosbeak | 42,001.07 | 26.11 | 215.63 | -0.51% | -0.13% | 2,140.63 | -5.1% | -1.33% | 1,858.75 | -4.43% | -1.16% |
| Eastern Wood-pewee | 35,957.2 | 30.88 | 187 | -0.52% | -0.16% | 1,862.93 | -5.2% | -1.60% | 1715.48 | -4.77% | -1.47% |
| Eastern Whip-poor-will and Common Nighthawk | 22,436.57 | 32.93 | 38.39 | -0.17% | -0.06% | 392.38 | -1.7% | -0.58% | 379.65 | -1.69% | -0.56% |
| Olive-sided Flycatcher | 10,810.52 | 17.67 | 89.83 | -0.83% | -0.15% | 543.88 | -5.0% | -0.89% | 359.8 | -3.33% | -0.59% |
| Yellow Rail | 1,601.78 | 28.37 | 2.39 | -0.15% | -0.04% | 31.12 | -1.9% | -0.55% | 11.17 | -0.70% | -0.20% |

Notes:
Barn Swallow and Bank Swallow models were not available (see text for details).
Percentage additional change in species habitat is calculated as = (Species Habitat Area in the LSA or RSA Subjected to Indirect Effect During Mine Operations) / (Total Species Habitat Area in the LSA or RSA).

**Table 9.7-14: Indirect Effects, Noise, on Migratory Bird SAR Habitat in the LSA and RSA**

| Species | LSA Habitat | | Construction Noise | | | Operation Noise | | | Closure Noise | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Habitat in LSA | % of Total Habitat in LSA | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change | Effect Area | LSA % Change | RSA % Change |
| Canada Warbler | 15,887.19 | 38.33 | 2,674.68 | -16.8% | -6.45% | 3,228.79 | -20.3% | -7.79% | 26.77 | -0.17% | -0.06% |
| Evening Grosbeak | 42,001.07 | 26.11 | 6,201.99 | -14.8% | -3.86% | 7,100.12 | -16.9% | -4.41% | 63.03 | -0.15% | -0.04% |
| Eastern Wood-pewee | 35,957.2 | 30.88 | 5,333.55 | -14.8% | -4.58% | 6,128.39 | -17.0% | -5.26% | 60.25 | -0.17% | -0.05% |
| Eastern Whip-poor-will and Common Nighthawk | 22,436.57 | 32.93 | 1,641.63 | -7.3% | -2.41% | 1,869.01 | -8.3% | -2.74% | 21.25 | -0.09% | -0.03% |
| Olive-sided Flycatcher | 10,810.52 | 17.67 | 1,509.47 | -14.0% | -2.47% | 1,597.37 | -14.8% | -2.61% | 10.51 | -0.10% | -0.02% |
| Yellow Rail | 1,601.78 | 28.37 | 108.69 | -6.8% | -1.93% | 130.38 | -8.1% | -2.31% | 0 | 0.00% | 0.00% |

Notes:
Barn Swallow and Bank Swallow models were not available (see text for details)
Indirect effects from noise use daytime noise modelling
Percentage additional change in species habitat is calculated as = (Species Habitat Area in the LSA or RSA Subjected to Indirect Effect During Mine Operations) / (Total Species Habitat Area in the LSA or RSA).

**Table 9.7-15: Migratory Bird SAR Density in PA and RSA**

| Species | Preferred Habitat | Model Type | Density PA (birds / ha) | Density LSA (birds / ha) | Density in RSA (birds / ha) |
|---|---|---|---|---|---|
| Canada Warbler | Mixed forests | BAM | 0.0212 | 0.0173 | 0.0183 |
| Evening Grosbeak | Coniferous forests | BAM | 0.0241 | 0.0203 | 0.0215 |
| Eastern Wood-pewee | Mixed forests | BAM | 0.0021 | 0.0018 | 0.0020 |
| Olive-sided Flycatcher | Open coniferous forests | GLM | 0.0002 | 0.0124 | 0.0004 |
| Barn Swallow | Syntropic | BAM | 0.0145 | 0.0173 | 0.0132 |
| Bank Swallow | Riparian | BAM | 0.0004 | 0.0203 | 0.0005 |

Notes:
Eastern Whip-poor-will, Common Nighthawk, and Yellow Rail models were not available (see text for details).
GLM use an offset to account for imperfect detection (Appendix M-2).

**Table 9.7-16: Impacted Population in the RSA and Number of Individuals in the PA for Migratory Birds SAR**

| Species | Preferred Habitat | Inferred Population Within PA (1) | Inferred Population within RSA | Percent Of Population Impacted (2) | Increase in Density (3) (birds/ha) |
|---|---|---|---|---|---|
| Canada Warbler | Mixed forests | 70.96 | 4,645.78 | 1.53 | 0.0003 |
| Evening Grosbeak | Coniferous forests | 80.76 | 5,453.88 | 1.48 | 0.0003 |
| Eastern Wood-pewee | Mixed forests | 7.08 | 499 | 1.42 | < 0.0001 |
| Olive-sided Flycatcher | Open coniferous forests | 0.79 | 103.14 | 0.76 | < 0.0001 |
| Barn Swallow | Syntropic | 48.46 | 3,340.78 | 1.45 | 0.0002 |
| Bank Swallow | Riparian | 1.47 | 116.11 | 1.26 | < 0.0001 |

Notes:
LSA population data is not provided. The TISG defines the LSA as an undefined area beyond the PA. In contrast, the RSA is defined at an ecological scale, which is preferred for defining populations. Changes in density in the LSA are provided in Table 9.7-18 and Table 9.7-19.
Eastern Whip-poor-will, Common Nighthawk, and Yellow Rail models were not available (see text for details).
1. Using density rasters, populations are inferred by summing the number of individuals predicted in each raster cell.
2. Population in PA / Population in RSA.
3. (Number of inferred individuals in RSA / (Area of RSA – Area of PA)) – (Number of inferred individuals in RSA / Area of RSA).

**Table 9.7-17: Impacted Population Related to Indirect Effects for Migratory Birds SAR**

| Species | Preferred Habitat | % of Impacted Population (1) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Operations Groundwater drawdown (2) | Construction particulate matter (air) (3) | Operations particulate matter (air) (3) | Construction Noise (4) | Operation Noise (4) | Closure Noise (4) |
| Canada Warbler | Mixed forests | 0.13 | 1.14 | 0.94 | 3.47 | 3.90 | 0.03 |
| Evening Grosbeak | Coniferous forests | 0.13 | 1.12 | 0.91 | 3.46 | 3.89 | 0.03 |
| Eastern Wood-pewee | Mixed forests | 0.13 | 1.08 | 0.88 | 3.28 | 3.68 | 0.03 |
| Olive-sided Flycatcher | Open coniferous forests | 0.12 | 0.90 | 0.66 | 2.66 | 2.99 | 0.01 |
| Barn Swallow | Syntropic | 0.13 | 1.12 | 0.91 | 3.39 | 3.80 | 0.03 |
| Bank Swallow | Riparian | 0.17 | 1.20 | 0.96 | 3.88 | 4.39 | 0.02 |

Notes:
Eastern Whip-poor-will, Common Nighthawk and Yellow Rail models were not available (see text for details).
1. (Inferred population in impact zone / total inferred population in RSA) * 100.
2. 1 m drawdown.
3. 50% contour for a suspended particulate matter value of 60 ug/$m^3$.
4. 40 dBA daytime noise contour.

**Table 9.7-18: Indirect Effects, Groundwater and Air, on Migratory Bird Density in the LSA**

| Species | Baseline | Operations Groundwater Drawdown | | Construction Particulate Matter (Air) | | Operations Particulate Matter (Air) | |
|---|---|---|---|---|---|---|---|
| | Average Density in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase in LSA (birds/ha) |
| Canada Warbler | 0.0173 | 0.0211 | 0.0010 | 0.0203 | 0.0016 | 0.0207 | 0.0015 |
| Evening Grosbeak | 0.0203 | 0.0234 | 0.0011 | 0.0234 | 0.0019 | 0.0238 | 0.0017 |
| Eastern Wood-pewee | 0.0018 | 0.0022 | 0.0001 | 0.0021 | 0.0002 | 0.0021 | 0.0002 |
| Olive-sided Flycatcher | 0.0004 | 0.0004 | 0.0000 | 0.0004 | 0.0000 | 0.0003 | 0.0000 |
| Barn Swallow | 0.0124 | 0.0150 | 0.0007 | 0.0143 | 0.0012 | 0.0145 | 0.0011 |
| Bank Swallow | 0.0005 | 0.0007 | 0.0000 | 0.0005 | 0.0001 | 0.0005 | 0.0000 |

Notes:
Eastern Whip-poor-will, Common Nighthawk, and Yellow Rail models were not available (see Section 9.4.3 for details).
Density increase is calculated as: (Number of inferred individuals in LSA / (Area of LSA – Impacted Area)) – (Number of inferred individuals in LSA / Area of LSA).

**Table 9.7-19: Indirect Effects, Noise, on Migratory Bird SAR Density in the LSA**

| Species | Baseline | Construction Noise | | Operation Noise | | Closure Noise | |
|---|---|---|---|---|---|---|---|
| | Average Density in LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) | Average Density in ZOI (birds/ha) | Density Increase LSA (birds/ha) |
| Canada Warbler | 0.0173 | 0.0193 | 0.0035 | 0.0191 | 0.0039 | 0.0201 | 0.0009 |
| Evening Grosbeak | 0.0203 | 0.0226 | 0.0041 | 0.0224 | 0.0046 | 0.0242 | 0.0011 |
| Eastern Wood-pewee | 0.0018 | 0.0020 | 0.0004 | 0.0019 | 0.0004 | 0.0021 | 0.0001 |
| Olive-sided Flycatcher | 0.0004 | 0.0003 | 0.0001 | 0.0003 | 0.0001 | 0.0002 | 0.0000 |
| Barn Swallow | 0.0124 | 0.0136 | 0.0025 | 0.0134 | 0.0028 | 0.0145 | 0.0006 |
| Bank Swallow | 0.0005 | 0.0005 | 0.0001 | 0.0005 | 0.0001 | 0.0004 | 0.0000 |

Notes:
Eastern Whip-poor-will, Common Nighthawk, and Yellow Rail models were not available (see text for details).
Indirect effects from noise use daytime noise modelling.
Density increase = (Number of inferred individuals in LSA / (Area of LSA – Impacted Area)) – (Number of inferred individuals in LSA / Area of LSA).

## 9.8 Determination of Significance and Confidence

### 9.8.1 Change in the Abundance of Habitat

With the implementation of mitigation measures and expected offset via restoration during closure, the magnitude of the effect on migratory birds is Level I (Level I) and restricted to the PA (Level I). The effect will occur once (Level I), be continuous throughout construction and operations (Level III), and be partially reversible at closure (Level II). The small, localized effect can be accommodated within the ecological context (Level I). As a result, the adverse residual effect of the change to habitat abundance is predicted to be not significant.

### 9.8.2 Connectivity and Quality of Habitat

With the implementation of mitigation measures, the magnitude of the effect on migratory birds is low (Level I) and restricted to the RSA (Level II). The effect will occur intermittently (Level II), be continuous throughout construction and operations (Level III), and be partially reversible at closure (Level II). The small, localized effect can be accommodated within the ecological context (Level I). As a result, the adverse residual effect of changes to connectivity and quality of habitat is predicted to be not significant.

### 9.8.3 Change in Density and Population

With the implementation of mitigation measures, the magnitude of the effect on migratory birds is low (Level I) and restricted to the RSA (Level II). The effect will occur intermittently (Level II), be continuous (Level III), and be partially reversible during the Project phases (Level II). This effect can be accommodated within the ecological context (Level I). As a result, the adverse residual effect of the change in density and population for migratory birds is predicted to be not significant.

### 9.8.4 Change in Risk of Mortality

With the implementation of mitigation measures, the residual effect to the change in risk of mortality for migratory birds will be low. Overall, the magnitude of the effect on migratory birds is low (Level I) and restricted to the RSA (Level II). The effect will be intermittent (Level II) and continuous through construction and operations (Level II). It will be reversible at closure (Level I). This effect can be accommodated within the ecological context (Level I). As a result, the adverse residual effect on the change in mortality risk for migratory birds is predicted to be not significant.

### 9.8.5 Change to Migratory Bird SAR

With the implementation of mitigation measures and restoration, the residual effect on the habitat of migratory bird SAR is expected to be low. However, there may be a residual effect on migratory bird SAR due to their low population densities. As such, the magnitude of this effect on migratory bird SAR is moderate (Level II) and restricted to the RSA (Level II). The effect will occur intermittently (Level II), be continuous (Level III), and is partially reversible at closure (Level II). This effect can be accommodated within the ecological context (Level I). As a result, the adverse residual effect of the change in risk of mortality for migratory birds is predicted to be not significant.

### 9.8.6 Confidence

The level of confidence in the effects predictions is moderate to high due to comprehensive habitat mapping and modelling, as well as the use of conservative assumptions throughout the assessment. Direct effects (e.g., habitat clearing) are well understood and quantifiable. By applying conservative assumptions, such as clearing the entire PA and accounting for worst case scenarios related to indirect effects, the assessment minimizes the risk of underestimating potential impacts. However, there is moderate uncertainty regarding indirect effects (e.g., edge effects and hydrological changes) and ecological interactions (e.g., changes in predator - prey relationships), as these are more challenging to predict and may vary depending on site conditions and over time.

Limitations include the accuracy and completeness of available FRI data, the course scale of available BAM, and uncertainties in future land use and reclamation details. Despite these, the assessment approach is consistent with industry standards and regulatory expectations, supporting confidence in the overall conclusions.

## 9.9 Change Outcome

### 9.9.1 Zone of Changes

The extent of change is determined by the physical overprinting of habitat by Project facilities, as well as the associated effects of noise, dust and water drawdown on migratory bird habitats. The zone of determinate change will primarily be constrained to the PA. Beyond the PA, the worst case scenario for migratory birds would be potential effects from noise. Modelling suggests that these effects could extend between approximately 1.8 to 5 km from the edge of the PA into the LSA. These combined effects represent the certain and potential zone of change for migratory birds.

### 9.9.2 Change Management

These changes to migratory birds and their habitat are managed through regulatory mechanisms, including the MBCA (federal) and SARA (federal).

Activities associated with the Project that may affect migratory birds and their habitat are considered herein. The assessment of residual effects presented assumes that mitigation measures will be implemented to prevent damage and harm to migratory birds, their eggs, and their habitats. If these conditions cannot be met, additional permitting may be required.

Potential conditions for federal approval:

- Project development will avoid harm to migratory birds by removing habitat during appropriate timing windows as practical
- Project development will avoid harm to Bank Swallow by removing residences during appropriate timing windows.

## 9.10 References

Adams, C.A., Fernández-Juricic, E., Bayne, E.M. and C.C. St. Clair. 2021. Effects of artificial light on Bird Movement and distribution: A systematic map. Environmental Evidence, 10(1). Accessed from: https://doi.org/10.1186/s13750-021-00246-8.

Adams, C.A., Clair, C.C., Knight, E.C. and E.M. Bayne. 2024. Behaviour and landscape contexts determine the effects of artificial light on two crepuscular bird species. Landscape Ecology, 39(4). Accessed from: https://doi.org/10.1007/s10980-024-01875-3.

Andrén, H., Delin, A., Seiler, A. and H. Andren, H. 1997. Population response to landscape changes depends on specialization to different landscape elements. Oikos, 80(1), 193. Accessed from: https://doi.org/10.2307/3546534.

Betts, M.G., Forbes, G.J. and A.W. Diamond. 2007. Thresholds in songbird occurrence in relation to landscape structure. Conservation Biology, 21(4), 1046–1058. Accessed from: https://doi.org/10.1111/j.1523-1739.2007.00723.x.

Biodivcanada. 1995. Canadian Biodiversity Strategy: Canada's Response to the Convention on Biological Diversity. Accessed from: https://www.biodivcanada.ca/national-biodiversity-strategy-and-action-plan/canadian-biodiversity-strategy.

Bishop, C.A. and J.M. Brogan, J. M. 2013. Estimates of avian mortality attributed to vehicle collisions in Canada. Avian Conservation and Ecology, 8(2). Accessed from: https://doi.org/10.5751/ace-00604-080202.

Boreal Avian Modelling Project (BAM). 2020. Species-Specific Habitat Suitability Maps for Boreal-Breeding Passerine Species. Accessed April 8, 2025 from: https://borealbirds.github.io.

Boyce, M.S., Sinclair, A.R.E. and G.C. White. 1999. Seasonal compensation of predation and harvesting. Oikos, 87(3), 419. Accessed from: https://doi.org/10.2307/3546808.

Coldren, C.L. 1998. The effects of habitat fragmentation on the Golden-cheeked Warbler. Doctoral dissertation. Texas A&M University. Accessed from: https://www.depts.ttu.edu/pss/ccoldren/Dissertation_Coldren_1998.pdf.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018. COSEWIC assessment and status report on the Olive-sided Flycatcher Contopus cooperi in Canada. Ottawa ON: Committee on the Status of Endangered Wildlife in Canada.

Convention on Biological Diversity (CBD). 2006a. The Convention on Biological Diversity. Updated 10 December 2025. Accessed from: https://www.cbd.int/convention.

Convention on Biological Diversity (CBD). 2006b. Global Biodiversity Outlook: Chapter 2 The Convention on Biological Diversity. Accessed from: https://www.cbd.int/doc/publications/gbo/gbo-ch-02-en.pdf.

Convention on Biological Diversity (CBD). 2006c. Kunming-Montreal Global Biodiversity Framework. Accessed from: https://www.cbd.int/gbf.

Convention on Biological Diversity (CBD). 2006d (copyright). 23 Targets of Kunming-Montreal Global Biodiversity Framework. Accessed from: https://storymaps.arcgis.com/stories/8f7458bb4e71445a817ffa93159a71cc.

Courchamp, F., Clutton-Brock, T. and B. Grenfell. 1999. Inverse density dependence and the Allee effect. Trends in Ecology & Evolution, 14(10), 405-410. Accessed from: https://doi.org/10.1016/s0169-5347(99)01683-3.

Courchamp, F., Berec, L. and J. Gascoigne. 2008. Allee effects in ecology and conservation. Oxford University Press.

Creemers, J., Eens, M., Ulenaers, E., Lathouwers, M. and R. Evens. 2025. Skyglow facilitates prey detection in a crepuscular insectivore: Distant light sources create bright skies. Environmental Pollution, 369, 125821. Accessed from: https://doi.org/10.1016/j.envpol.2025.125821.

Donato, D.B., O. Nichols, H. Possingham, M. Moore, P.F. Ricci and B.N. Noller. 2007. A Critical Review of the Effects of Gold Cyanide-bearing Tailings Solutions on Wildlife. Environment International. Vol. 33, Issue 7, October 2007. Pages 974-984.

Dooling, R.J. and A.N. Popper. 2007. The Effects of Highway Noise on Birds. Report to the California Department of Transportation, Contract 43AO139. Accessed from: Accessed from: https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/bio-effects-hwy-noise-birds-100707-a11y.pdf.

Environment Canada (EC). 2014. Bird conservation strategy for Region 8: Ontario boreal softwood shield. Abridged Version. Accessed on April 30, 2025 from: https://www.canada.ca/en/environment-climate-change/services/migratory-bird-conservation/publications/strategy-region-8-boreal-softwood.html.

Environment Canada (EC). 2016a. Recovery Strategy for the Common Nighthawk (Chordeiles minor) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 49 pp.

Environment Canada (EC). 2016b. Recovery Strategy for the Canada Warbler (Cardellina canadensis) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 56 pp.

Environment and Climate Change Canada (ECCC). 2018. Recovery Strategy for the Eastern Whip-poor-will (Antrostomus vociferus) in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. vi + 107 pp.

Environment and Climate Change Canada (ECCC). 2022a. Recovery Strategy for the Bank Swallow (Riparia riparia) in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa.

Environment and Climate Change Canada (ECCC). 2022b. Management Plan for the Evening Grosbeak (Coccothraustes vespertinus) in Canada. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa.

Environment and Climate Change Canada (ECCC). 2023a. Management Plan for the Eastern Wood-pewee (Contopus virens) in Canada [Proposed]. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa.

Environment and Climate Change Canada (ECCC). 2023b. Guidelines to avoid harm to migratory birds. Accessed from: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html.

Farmer, A. M. 1993. The effects of dust on vegetation - a review. Environmental Pollution, 79(1), 63–75. Accessed from : https://doi.org/10.1016/0269-7491(93)90179-r.

Flaspohler, D.J., Temple, S.A. and R.N. Rosenfield. 2001. Species-Specific edge effects on nest success and breeding bird density in a forested landscape. Ecological Applications, 11(1), 32. Accessed from: https://doi.org/10.2307/3061053.

Food and Agriculture Organization of the United Nations (FAO). 2026. Biodiversity: Kunming-Montreal Global Biodiversity Framework. Accessed from: https://www.unep.org/interactives/biodiversity-sdgs-tool/global-biodiversity-framework.html.

Francis, C. D. and J.R. Barber, J. R. 2013. A framework for understanding noise impacts on wildlife: An urgent conservation priority. Frontiers in Ecology and the Environment, 11(6), 305–313. Accessed from: https://doi.org/10.1890/120183.

Frid, A. and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1): 11. Accessed from: http://www.consecol.org/vol6/iss1/art11/.

Foley, G. and R. Brigham, R. 2025. Influences on the use of gravel roads as night roosts by Common Nighthawks in the Boreal Forest. Avian Conservation and Ecology, 20(1). Accessed from: https://doi.org/10.5751/ace-02880-200124.

Foley, G. J. and L.S. Wszola. 2017. Observation of Common Nighthawks (Chordeiles Minor) and bats (Chiroptera) feeding concurrently. Northeastern Naturalist, 24(2). Accessed from: https://doi.org/10.1656/045.024.0208.

Forman, R. T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics, 29(1), 207-231. Accessed from: https://doi.org/10.1146/annurev.ecolsys.29.1.207.

Gehring, J., Kerlinger, P. and A.M. Manville. 2009. Communication Towers, lights, and birds: Successful methods of reducing the frequency of avian collisions. Ecological Applications, 19(2), 505–514. Accessed from: https://doi.org/10.1890/07-1708.1.

Gilroy, J. and W. Sutherland. 2007. Beyond ecological traps: Perceptual Errors and undervalued resources. Trends in Ecology & Evolution, 22(7), 351–356. Accessed from: https://doi.org/10.1016/j.tree.2007.03.014.

Government of Canada. 2017. Birds protected under the Migratory Birds Convention Act. Accessed February 12, 2025 from: https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html.

Government of Canada. 2018. Bird Conservation Regions and Strategies. Accessed from: https://www.canada.ca/en/environment-climate-change/services/migratory-bird-conservation/regions-strategies.html.

Government of Canada. 2019. Species at Risk Act Public Registry. Residence Descriptions. Description of residence for Barn Swallow (Hirundo rustica) in Canada. May 2019. Accessed from: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/residence-descriptions/barn-swallow.html.

Government of Canada. 2025. Species at Risk Act Public Registry. Yellow Rail (Coturnicops noveboracensis). September 2025. Accessed from: https://species-registry.canada.ca/index-en.html#/species/574-1.

Haddad, N. M. et al. 2015. Habitat fragmentation and its lasting impact on Earth's ecosystems. Science Advances, 1(2). Accessed from: https://doi.org/10.1126/sciadv.1500052

Hagan, J. M., Haegen, W. M. V. and P.S. McKinley. 1996. The early development of forest fragmentation effects on birds. Conservation Biology, 10(1), 188–202. Accessed from: https://doi.org/10.1046/j.1523-1739.1996.10010188.x.

Hargis, C. D., Bissonette, John. A. and Turner, D. L. (1999). The influence of forest fragmentation and landscape pattern on American Martens. Journal of Applied Ecology, 36(1), 157–172. https://doi.org/10.1046/j.1365-2664.1999.00377.x.

Heagy, A., D. Badzinski, D. Bradley, M. Falconer, J. McCracken, R.A. Reid and K. Richardson. 2014. Recovery Strategy for the Barn Swallow (Hirundo rustica) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 64 pp.

International Cyanide Management Institute (ICMI). 2021. The International Cyanide Management Code. Accessed from: https://cyanidecode.org/wp-content/uploads/2021/06/01-The-Cyanide-Code-JUNE-2021.pdf.

Jaeger, J.A.G. 2000. Landscape division, splitting index, and effective mesh size: new measures of landscape fragmentation. Landscape Ecology, 15, 115-130.

Kramer, A. M., Dennis, B., Liebhold, A. M. and J.M. Drake. 2009. The evidence for Allee effects. Population Ecology, 51(3), 341–354. Accessed from: https://doi.org/10.1007/s10144-009-0152-6.

Kuparinen, A. 2017. The mechanistic basis of demographic Allee effects: The search for mates. Journal of Animal Ecology, 87(1), 4–6. Accessed from: https://doi.org/10.1111/1365-2656.12774.

Kurki, S., Nikula, A., Helle, P. and Linden, H. (2000). Landscape Fragmentation and forest composition effects on grouse breeding success in boreal forests. Ecology, 81(7), 1985. https://doi.org/10.2307/177287.

LeBrun, J. J., Thogmartin, W. E., Thompson, F. R., Dijak, W. D. and J.J. Millspaugh. 2016. Assessing the sensitivity of avian species abundance to land cover and climate. Ecosphere, 7(6). Accessed from: https://doi.org/10.1002/ecs2.1359.

Lindenmayer, D. B., Lane, P. W., Barton, P. S., Crane, M., Ikin, K., Michael, D. and S. Okada. 2016. Long-term bird colonization and turnover in restored woodlands. Biodiversity and Conservation, 25(8), 1587–1603. Accessed from: https://doi.org/10.1007/s10531-016-1140-8.

Lindsay, K. and B. Collins. 1992. Landscape ecology of birds breeding in temperate forest fragments. In J. M. Hagan III and D. W. Johnston (Eds.), Ecology and conservation of neotropical migrant landbirds, pp. 443–454. Smithsonian Institution Press.

Machtans, C.S., Wedeles, C.H. and E.M. Bayne. 2013. A first estimate for Canada of the number of birds killed by colliding with building windows. Avian Conservation and Ecology, 8(2).

Marzluff, J.M., Millspaugh, J.J., Ceder, K.R., Oliver, C.D., Withey, J., McCarter, J.B., Mason, C.L. and J. Comnick. 2002. Modeling changes in wildlife habitat and timber revenues in response to forest management. Forest Science, 48(2), 191–202. Accessed from: https://doi.org/10.1093/forestscience/48.2.191.

McClure, C. J. W., Ware, H. E., Carlisle, J., Kaltenecker, G. and J.R. Barber. 2013. An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. Proceedings of the Royal Society B Biological Sciences, 280(1773), 20132290. Accessed from: https://doi.org/10.1098/rspb.2013.2290.

Milles, A., Banitz, T., Bielcik, M., Frank, K., Gallagher, C. A., Jeltsch, F., Jepsen, J. U., Oro, D., Radchuk, V. and V. Grimm. 2023. Local buffer mechanisms for population persistence. Trends in Ecology and Evolution, 38(11), 1051–1059. Accessed from: https://doi.org/10.1016/j.tree.2023.06.006.

Ministry of the Environment, Conservation and Parks (MECP). 2019. Recovery Strategy for the Eastern Whip-poor-will (Antrostomus vociferus) in Ontario. Ontario Recovery Strategy Series. Prepared by the Ministry of the Environment, Conservation and Parks, Peterborough, Ontario. iv + 6 pp. + Appendix. Ministry of Environment Conservation and Parks. 2022. Bank Swallow General Habitat Description. Accessed from: https://www.ontario.ca/page/bank-swallow-general-habitat-description.

Ministry of Environment Conservation and Parks (MECP). 2022. Bank Swallow. Accessed from: https://www.ontario.ca/document/2022-review-progress-towards-protection-and-recovery-ontarios-species-risk/bank-swallow.

Ministry of Environment Conservation and Parks (MECP). 2023. Barn Swallow: Hirundo rustica. Accessed from: https://www.ontario.ca/page/barn-swallow.

Moudrý, V., Moudrá, L., Barták, V., Bejček, V., Gdulová, K., Hendrychová, M., Moravec, D., Musil, P., Rocchini, D., Šťastný, K., Volf, O. and M. Šálek. 2021. The role of the vegetation structure, primary productivity and senescence derived from airborne LiDAR and hyperspectral data for birds diversity and rarity on a restored site. Landscape and Urban Planning, 210, 104064. Accessed from: https://doi.org/10.1016/j.landurbplan.2021.104064.

Nichols, O.G. and C.D. Grant. 2007. Vertebrate Fauna Recolonization of Restored Bauxite Mines—Key Findings from Almost 30 Years of Monitoring and Research. Restoration Ecology, 15(s4). Accessed from: https://doi.org/10.1111/j.1526-100x.2007.00299.x.

Paradis, E., Baillie, S.R., Sutherland, W.J. and R.D. Gregory. 2002. Exploring density-dependent relationships in demographic parameters in populations of birds at a large spatial scale. Oikos, 97(2), 293–307. Accessed from: https://doi.org/10.1034/j.1600-0706.2002.970215.x.

Poot, H., Ens B.J. , de Vries, H., Donners, M.A.H., Wernand, M.R. and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. Ecology and Society 13(2): 47. [online] URL: Accessed from: http://www.ecologyandsociety. org/vol13/iss2/art47/.

Rheindt, F.E. 2003. The impact of roads on birds: Does song frequency play a role in determining susceptibility to noise pollution? Journal Ornithologie, 144(3), 295–306. Accessed from: https://doi.org/10.1046/j.1439-0361.2003.03004.x.

Rodgers, J.A. and S.T. Schwikert. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbance by personal watercraft and outboard-powered boats.

Conservation Biology, 16(1), 216–224. Accessed from: https://doi.org/10.1046/j.1523-1739.2002.00316.x.

Rose, K. A., Cowan, J. H., Winemiller, K. O., Myers, R. A. and R. Hilborn. 2001. Compensatory density dependence in fish populations: importance, controversy, understanding and prognosis. Fish and Fisheries, 2(4), 293–327. Accessed from: https://doi.org/10.1046/j.1467-2960.2001.00056.x.

Shannon, G., McKenna, M. F., Angeloni, L. M., Crooks, K. R., Fristrup, K. M., Brown, E., Warner, K. A., Nelson, M. D., White, C., Briggs, J., McFarland, S. and Wittemyer, G. 2016. A synthesis of two decades of research documenting the effects of noise on wildlife. Biological Reviews, 91(4), 982-1005. https://doi.org/10.1111/brv.12207.

Sinclair, A.R.E. and R.P. Pech. 1996. Density dependence, stochasticity, compensation and predator regulation. Oikos, 75(2), 164. https://doi.org/10.2307/3546240.

Solymos, P., Matsuoka, S. M., Bayne, E. M., Lele, S. R., Fontaine, P., Cumming, S.G., Stralberg, D., Schmiegelow, F.K. and S.J. Song. 2013. Calibrating indices of avian density from non-standardized survey data: Making the most of a messy situation. Methods in Ecology and Evolution, 4(11), 1047-1058. Accessed from: https://doi.org/10.1111/2041-210x.12106.

Stephens, P. A. and Sutherland, W. J. 1999. Consequences of the Allee effect for behaviour, ecology and conservation. Trends in Ecology and Evolution, 14(10), 401-405. Accessed from: https://doi.org/10.1016/s0169-5347(99)01684-5.

St-Laurent, M., Dussault, C., Ferron, J. and Gagnon, R. 2009. Dissecting habitat loss and fragmentation effects following logging in boreal forest: Conservation perspectives from landscape simulations. Biological Conservation, 142(10), 2240-2249. Accessed from: https://doi.org/10.1016/j.biocon.2009.04.025.

Stralberg, D. 2012. Habitat suitability maps for boreal-breeding passerine species [Data set]. Accessed from: https://zenodo.org/records/3847272#.YMoT9_lKhaT.

Swaddle, J. P., Francis, C. D., Barber, J. R., Cooper, C. B., Kyba, C. C., Dominoni, D. M., Shannon, G., Aschehoug, E., Goodwin, S. E., Kawahara, A. Y., Luther, D., Spoelstra, K., Voss, M. and Longcore, T. 2015. A framework to assess evolutionary responses to anthropogenic light and sound. Trends in Ecology & Evolution, 30(9), 550–560. Accessed from: https://doi.org/10.1016/j.tree.2015.06.009.

United Nations Conference on Environment and Development (UNCED). 1992. Agenda 21. Accessed from: https://sdgs.un.org/publications/agenda21.

United Nations (UN) Documents Cooperation Circles. 2026. Agenda 21 Chapter 15 Conservation of Biological Diversity. Accessed from: http://un-documents.net/a21-15.htm.

Wood, W. E. and S.M. Yezerinac. 2006. Song Sparrow (Melospiza melodia) Song Varies with Urban Noise. The Auk, 123(3), 650–659. Accessed from: https://doi.org/10.1642/0004-8038(2006)123[650:SSMMSV]2.0.CO;2.

Zhao, X., Zhang, M., Che, X. and F. Zou. 2020. Blue light attracts nocturnally migrating birds. The Condor: Ornithological Applications. 122(2). Accessed from: https://doi.org/10.1093/condor/duaa002.