Best Management Practices for the Protection, Creation and Maintenance of Bank Swallow Habitat in Ontario

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This document includes best available information as of the date of publication and will be updated as new information becomes available. If you are interested in providing information for consideration in updates of this document, please email esapermits@ontario.ca.

1.0 Introduction

The purpose of the Ontario Ministry of Natural Resources and Forestry (MNRF) Best Management Practices for the protection, creation and maintenance of Bank Swallow habitat in Ontario (hereafter referred to as the BMP document) is to provide information to support effective management of Bank Swallows, listed as Threatened in Ontario. Implementing aspects of the BMP is not mandatory, but doing so is encouraged and may facilitate compliance with relevant provincial and federal regulations.

In Ontario, Bank Swallows (*Riparia riparia*) historically nested in eroding slopes along rivers and lakes, but have successfully adjusted to human-influenced and created environments, with many colonies now located in sand and gravel pits. This BMP document focuses largely on habitat associated with sand and gravel pits and the intended audience is primarily the aggregate industry. However, it is also intended to assist others with similar interests.

This BMP document provides information on measures to reduce effects on Bank Swallow through protection of colonies and measures to discourage nesting in areas where project activities will occur. It also provides information on the creation and maintenance of nesting habitat for Bank Swallows. Key considerations for employing these measures or techniques are defined, with information on the likelihood of success for each method and how to monitor their effectiveness once implemented.

This BMP document was developed based on best practices and findings from peer-reviewed papers, unpublished reports and consultation with relevant stakeholders (including academics, other researchers and aggregate operators). It represents the best currently available information and should be reviewed and modified as new information becomes available. The document does not circumvent or supersede requirements of other applicable provincial or federal legislation including, but not limited to the following acts and their associated regulations:

- *Crown Liability and Proceedings Act,* 1985
- *Aggregate Resources Act*, 1990
- *Occupational Health and Safety Act*, 1990
- *Professional Engineers Act,* 1990
- *Migratory Birds Convention Act,* 1994
- *Workplace Safety and Insurance Act*, 1997
- *Endangered Species Act,* 2007

2.0 Endangered Species Act, 2007 (ESA)

The ESA provides the legislative framework for the protection and recovery of species at risk in Ontario. Section 9 of the ESA includes prohibitions against activities that result in killing, harming, harassing, capturing or taking a living member of a species that is listed as extirpated, endangered or threatened on the Species at Risk in Ontario (SARO) List. Section 10 of the ESA includes prohibitions against damage or destruction of the habitat of an endangered or threatened species.

The ESA contains provisions that enable the Minister to issue permits and enter into agreements to authorize activities that would otherwise be prohibited and Ontario Regulation 242/08 sets out conditional exemptions from prohibitions under the Act for certain activities.

Additional information can be found on the Government of Ontario's website or through the following links:

- ESA
- Ontario Regulation 242/08
- Pits and Quarries Regulation Factsheet

2.1 Pits and Quarries Regulation

Under Section 23.14 (pits and quarries provision) of ESA Ontario Regulation 242/08, eligible aggregate producers may undertake activities that would otherwise contravene the ESA, provided they register and follow the regulatory conditions. This provision applies to pits or quarries that may affect the habitat of an endangered or threatened species, but which began operating prior to the species being listed, or before the species first appeared on the site. The regulatory conditions include developing and implementing a mitigation plan and reducing adverse effects on the species and its habitat (see Section 2.2).

Mitigation plans must be prepared by a person with expertise with the species and should include the best available information. This BMP will assist operators with following the rules in Ontario Regulation 242/08 to help inform steps that can be taken to minimize adverse effects (through protection, prevention and avoidance measures) and that can contribute to a mitigation plan (creating and maintaining Bank Swallow habitat).

2.2 General Habitat Description

Bank Swallow receives habitat protection under the ESA. The *General Habitat Description for the Bank Swallow* (MNRF 2015b) provides information on the area of habitat protected by the ESA, and comprises three categories:

Category 1

The Bank Swallow breeding colony, including the congregation of burrows and the substrate between and around them.

Category 2

The area within 50 m in front of the breeding colony bank face (i.e., the vertical face that is directly associated with and supports, the Category 1 habitat) to allow Bank Swallows to enter and exit burrows.

Category 3

The area of suitable foraging habitat within 500 m of the outer edge of the breeding colony.

The General Habitat Description can be used to assist with determining whether a proposed activity will damage or destroy the habitat of an endangered or threatened species by providing technical guidance to identify which areas of habitat a species may be more tolerant of alterations.

Proponents should refer to the General Habitat Description for the Bank Swallow for additional details, and should contact their local MNRF office (see Section 7.0) to obtain a copy or for additional information regarding this species.

3.0 Bank Swallow Ecology and Status

3.1 Description and Life History

Bank Swallow is the smallest swallow species in the western hemisphere (length 12 cm, weight 10-18 grams). Males and females are similar in size and appearance, with a grey-brown head, back, wings and tail (Photo 1). The white throat and belly are separated by a distinctive collar across the breast, which distinguishes them from other swallows (Photo 2). The most similar species in North America is Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), which is also largely brown above but has a uniformly grayish-brown chin and throat that fades gradually into whitish underparts. Bank Swallows also occur across Europe and much of Asia and Africa, where they are known as Sand Martins. Development of this BMP considered information from throughout the global range of this species.

Photo 1: Adult bank swallows flying (Robert Holden)

North American Bank Swallows are long-distance migrants that winter throughout northern and central South America (Garrison 1999). The first individuals typically return to Ontario beginning in mid- to late April; migration peaks in the second week of May but continues through the end of the month (eBird 2015). Bank Swallows are highly social, nest in colonies, and show high site fidelity where suitable nesting habitat exists; about half of the juveniles that survive over-wintering return to their natal area (Freer 1979; Szép 1990; Szép 1999).

The nesting period in Ontario spans from early May to mid-August, with the peak typically occurring in June

Photo 2: Adult bank swallow in flight (Tianna Burke)

(Peck and James 1987). Nest burrows are excavated primarily by males, to a depth of 20 to 150 cm, while females build most of the nest cup using grasses, plant stems, fibers and feathers (Garrison 1999; Falconer unpublished data 2013; Sandilands unpubl.). Digging a burrow can take 4-5 days to complete, with another 1-3 days for excavation of the nest chamber and building of the nest; initiation of nesting depends on local weather patterns and is delayed when spring is unusually cold and/or wet (Sandilands unpubl.). The number of burrows within a colony is almost always greater than the actual number of breeding Bank Swallow pairs; this is because males advertise to females by excavating burrows and they will dig additional burrows if initially unsuccessful at attracting a mate (Sandilands unpubl.). A general assumption of 50 percent burrow occupancy at a colony is often used (Wright et al. 2011). Bank Swallows in North America are believed to have a single brood annually (Garrison 1999). Isolated reports of potential second broods (e.g., as summarized by Hjertaas 1984) may represent later nesting attempts following initial failure.

Young fledge at 18-20 days old but still roost in the burrows for roughly one week after fledging (Garrison 1999). Most Bank Swallows in eastern Ontario have fledged by mid-July but nestlings have been seen in the burrows as late as the first week of August (Burke unpublished data 2016). Adults no longer roost inside the nest burrow after the young are 12 days old (Sandilands, unpubl.). In southwestern Ontario, adults begin to depart breeding areas as early as the last week of June, peaking in the first and second week of July (Falconer et al. 2016a).

3.2 Habitat and Distribution

Bank Swallows have been recorded throughout Ontario. Breeding distribution is directly related to available nesting habitat and Bank Swallow abundance is greatest in southern Ontario, where sand plains are more widespread (Chapman and Putnam 1984; Sandilands 2007). Bank Swallows require a vertical or near-vertical (at least 75 degrees) surface of suitable material that typically consists primarily of fine sand or silt (Hjertaas 1984; Photo 3). It is important that the slope is free of vegetation and sufficiently clear of talus at the base to prevent easy access by predators (Tozer and Richmond 2013). Nests are found in both naturally eroding banks and artificially created banks in pits, quarries, roadsides and stockpiles (Sandilands 2007). In Ontario, natural banks and aggregate pits are the most commonly used nesting locations, with a greater percentage of colonies occurring in manmade locations (Erskine 1979; Browning and Cadman unpublished data 2015). Tozer and Richmond (2013) found that nest success in aggregate pits and in lake bluffs is similar, at 66 and 75 percent respectively. While both natural and anthropogenic colonies exist in Ontario, there are other regions (e.g., Germany; Heidelberg Sand und Kies, no date) where Bank Swallows now overwhelmingly nest in pits, quarries and other anthropogenic locations.

Bank Swallows readily accept new nesting habitat, as reflected in Ontario and elsewhere through their extensive use of gravel and sand pits, as well as colonization of artificial nest structures designed for them (Bachmann et al. 2008; Cadman and Browning 2012). It may be that Bank Swallows use a variety of nesting options because the species is naturally adapted to changing landscapes (e.g., eroding river banks) and therefore predisposed to searching locally for new nesting options (Landschapsbeheer Flevoland 2014).

Photo 3: Bank Swallow colony (Tianna Burke)

Bank Swallows are aerial foragers, primarily consuming insects in flight. The diet of Bank Swallows in Ontario has not been studied in detail, but midges and other emergent aquatic invertebrates may be important (Falconer 2013, Sandilands unpub.). Bank Swallows tend to forage in flocks roughly 15 m above ground over open meadows, grasslands, open water and wetlands (Garrison 1999). As temperatures increase, Bank Swallows tend to forage higher; conversely during periods of cold temperatures they forage lower (Williams 1961; Taylor 1963; Turner and Rose 1989). Reported foraging distances between feeding areas and colonies vary: a study in New York reported a foraging distance within 800m of the colony (Garrison 1999); birds along the north shore of Lake Erie foraged within 1000 m of the colony (Falconer 2013): birds in aggregate sites in the United Kingdom remained within 260 m while young were being fed and within 690 m during nest building (Turner 1980). Garrison (1999) listed average foraging distance as 200-500 m.

During breeding, post-breeding and migration, Bank Swallows roost overnight in large groups, generally in reed or cane beds, or other areas of dense vegetation over water or large wetlands (Winkler 2006). In Ontario very few such roosts have been identified. The large marshes on the north shore of the Long Point peninsula on Lake Erie annually host large numbers of roosting Bank Swallows, with as many as 45,000 individuals recorded (Falconer unpublished data 2011, Bell pers. comm. 2012). Adult Bank Swallows from within roughly 40 km of the Long Point wetland complex use these wetlands throughout the nesting period as well as the post-breeding period (Falconer et al. 2016a). Bank Swallows nesting on Lake Ontario and at Peterborough area aggregate sites relocate to Long Point wetlands during the post-breeding period (Burke unpublished data 2016). During the breeding season, adult Bank Swallows tend to remain close to colonies; this pattern is stronger for those nesting on bluffs along Lake Erie and Lake Ontario than those in aggregate pits, most likely because of the greater tendency for high insect abundance along the lakes (Falconer et al. 2016).

3.3 Threats

Declines in Bank Swallow populations parallel those of other aerial insectivores in Ontario (Nebel et. al. 2010). Within the Lower Great Lakes – St. Lawrence region, Bank Swallow numbers have declined by approximately 95% since 1970 (NABCIC 2012). Numerous threats have been proposed as likely factors influencing the population decline, but their relative severity is not clearly understood and may vary among populations (Nebel et al. 2010, Calvert 2012, COSEWIC 2013, Smith et al. 2015, Falconer et al. 2016b). These threats are summarized below:

1. **Loss or disturbance of nesting habitat** – natural colonies have likely declined due to flood and erosion control. Birds that take advantage of stockpiles or extraction faces in aggregate pits can be adversely affected by unrestricted excavation or construction activities that occur during the breeding period.

2. **Loss or degradation of foraging and roosting habitat both in Canada and on migration and wintering grounds** – land cover and land use changes have resulted in the loss or degradation of insect-rich, open habitats (NABCIC 2012). In southern Ontario, the type and amount of open habitat (including changes in agricultural land use) has undergone drastic changes (Neave and Baldwin 2011).

3. **Environmental contaminants** – Bank Swallows may be adversely affected by exposure to pesticides, heavy metals, endocrine disrupters or other pollutants (Kirk et al. 2011). They may also experience indirect effects through reduced food supply arising from use of insecticides. Exposure to contaminants may be of particular concern on the wintering grounds (Nocera et al. 2014).

4. **Predators** – increasing populations of rats, raccoons, skunks, foxes, coyotes, gulls, falcons, crows or ravens could increase predation or disturbance at colonies and roosts.

5. **Climate change** – the effects of climate change on Bank Swallows have not been defined.

3.4 Status and Protection

In January 2014 the Committee on the Status of Species at Risk in Ontario (COSSARO) assessed Bank Swallow as Threatened in Ontario. The Bank Swallow was formally listed as Threatened in Ontario on the SARO list on June 27, 2014 (MNRF 2015a).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2013) also assessed the species as Threatened federally, but it has not yet been listed under the federal Species at Risk Act (Government of Canada 2002).

In Ontario, Bank Swallows and their habitat are protected by the *Endangered Species Act*, 2007 (ESA). Federally, Bank Swallows and their nests are protected from harm by the *Migratory Birds Convention Act*, 1994 (MBCA). Environment and Climate Change Canada provides avoidance guidelines and other recommendations for compliance with the MBCA (ECCC 2015).

4.0 Best Management Practices

Many Bank Swallow colonies in Ontario are found in operational sand and gravel pits. Bank Swallow nests are protected from harm by the *Migratory Birds Convention Act,* 1994 and the Endangered Species Act, 2007.

This document provides recommendations to support protection of Bank Swallow habitat (Section 4.1) and approaches to deter Bank Swallows from colonizing anthropogenic sites that require ongoing disturbance prior to and during the breeding season (Section 4.2). It also describes options for creating nesting habitat (Section 4.3) and guidance for effective site maintenance (Section 4.4). These considerations are not mutually exclusive; whether protecting habitat or preventing nesting in certain areas, consideration should also be given to enhancing, creating or maintaining habitat. Collectively, the recommendations provided are intended to assist aggregate operators and other stakeholders in reducing effects on Bank Swallows and managing their habitat based on best available science.

In applying these recommendations, the preferred approach is to protect existing Bank Swallow colony locations using the recommendations for protection (Section 4.1), which largely focus on spatial and temporal avoidance of nesting colonies, and to make efforts to maintain suitable nesting habitat (Section 4.4). However, for situations where aggregate removal activities cannot be avoided during the breeding season, consider creating habitat (Section 4.3) to reduce potential conflicts, and only if necessary, deterring Bank Swallows from nesting in areas with ongoing disturbance (Section 4.2). Note that to undertake this option it may be necessary to register under O.Reg. 242/08, 23.14.

The effectiveness of best management practices may vary to some degree based on site-specific considerations. In particular, the majority of recommendations pertain to nesting colonies, which in Ontario are typically active beginning in early May, but as early as mid-April in the southern part of the province. Consideration of this time period can be critical to the success of management plans.

4.1 Protection

If Bank Swallow colonies occur in portions of sites where no excavation or construction activities are required during the breeding season, the simplest and most effective action is to protect the colony by avoiding disturbance, in accordance with the recommendations outlined below.

Effective protection requires identifying which portions of sites to safeguard, clearly demarcating these areas, avoiding excavation or work in them, and informing personnel about the actions required. Additional management measures may be taken to protect Bank Swallow nesting, foraging and roosting habitat. These measures are intended to assist operators in avoiding direct effects on Bank Swallows or their habitat during the breeding season through providing safe nesting habitat.

4.1.1 Nesting Habitat

At sites where Bank Swallows are known to have nested previously, planning for site protection (or alternative forms of management) should begin well before the birds begin to return in mid- to late April. At new facilities, site operators should monitor suitable habitat for Bank Swallow activity by watching suitable habitat (from a distance) for presence of birds and burrows or signs of excavation (see Section 5.1).

Bank Swallows can begin to establish colonies quickly, often within a few days and in some instances over just one night. Monitoring for presence of Bank Swallows should therefore occur frequently, particularly in early spring when swallows they are expected to return and establish their colonies.

In some instances, operators may want to proactively provide and protect suitable habitat for Bank Swallows in an area that will not be excavated during the breeding season. Operators implementing prevention measures (Section 4.2) may particularly want to consider protecting other suitable habitat to reduce adverse effects. Within a large operation, there should always be some areas with suitable habitat left undisturbed throughout the breeding season (Bachmann et al. 2008). Note that while it is preferred, it is not necessary to maintain nest colonies in the same exact location from year to year. If existing colonies cannot be retained in the same locations, maintain an overall consistent level of availability of nesting habitat within a site.

Habitat characteristics favoured by Bank Swallows are described in Section 2.2, and details specific to colony preferences are outlined in Table 1. However, Bank Swallows have been observed nesting in various other locations including gullies created through rainfall and surface water flow, dredge piles from sediment ponds and stone dust piles (Cadman and Browning 2012; Ontario aggregate producers pers. comm. 2016). To identify areas with suitable habitat, consideration of substrate type is critical (see Section 4.3.1.3). Portions of sites that have suitable nesting substrate can be identified ahead of time and, if possible, protected from work during the breeding season. Effective habitat protection requires application of timing and siting considerations, as well as education and communication with those working on the site.

Examples of how to implement protection of nesting habitat include:

- Looking for habitat that may have previously been used for nesting (i.e., existing holes in a slope face) and avoiding it during the breeding season.
- Identifying previously unoccupied but suitable habitat within the site that is not scheduled for activities (or could feasibly be avoided) during the breeding season (including stockpiles and/or operational faces) and protecting these areas for Bank Swallows to create a nesting colony.
    - *The probability of areas being colonized by Bank Swallows may be lower if other suitable vertical faces are nearby (Cadman and Browning 2012). If this is the case, consider using prevention measures at locations where continued extraction is required through the breeding season (see Section 4.2).*
- Pre-planning to work on operational faces or stockpiles outside of the breeding season.
    - *If Bank Swallows have begun to excavate burrows at an active site, operators must take immediate action to avoid adverse effects on the birds, their nests or habitat. If avoidance throughout the breeding season is not possible, the operator should stop the activity and determine whether an ESA authorization is required. If in doubt, check with your local MNRF district office to determine the best course of action.*

Depending on the site and the approach taken, implementing these measures may require different levels of effort in pre-planning prior to the Bank Swallow breeding season and may not be logistically feasible for all sites.

Once habitat is protected, consider implementing enhancements (see Section 4.3) and maintenance measures (see Section 4.4) to improve overall nesting success within the site.

4.1.1.1 Temporal Considerations

Direct disturbance to active Bank Swallow colonies must be avoided during the breeding season. Where colonies have been established in previous years and suitable nesting habitat remains, plans should be made to work in other areas during the breeding period. Generally, Bank Swallows return to Ontario from their wintering grounds in late April (southern Ontario) to early May (northern Ontario). At this time, males begin to dig burrows in order to attract females. Young are reared by both parents and will usually fledge from the nests by the end of July or early August. Some pairs may nest a second time but this appears to be rare and has not been confirmed in Ontario. Specific timing for Bank Swallow arrival and departure may vary with geographic location. For example, the breeding season may begin and finish later in northern Ontario compared to more southern locations. It is recommended that aggregate producers speak with their local MNRF office or a qualified individual when breeding season timing windows are uncertain. Observations by a qualified individual may allow one to determine if Bank Swallows have vacated the colony.

4.1.1.2 Spatial Considerations

To protect Bank Swallow nests from harm, no excavation should occur at the colony while it is active and the colony should also be protected from disturbance (harm/harassment). The colony should be cordoned off to provide a defined setback distance within which activities are restricted. All site personnel should be informed of the colony and the restrictions associated with it.

Garrison (1998) indicates that Bank Swallows are generally tolerant of human-induced disturbance to some degree. In Ontario, Bank Swallows regularly nest within human-influenced areas where aggregate operations are occurring and in some cases have occupied bank faces near components of operation (e.g., hauling roads). It is possible that Bank Swallows, like many other birds, habituate or are more tolerant of vehicles and other machinery than foot traffic (Gahbauer pers. obs.; Holden pers. obs.).

While swallow colonies regularly occur and continue to persist with functioning operations in the vicinity, it is unclear to what extent sensory disturbance from excavation and operation may have implications on nesting productivity such as the relative fitness of fledglings. Data to support a science-based buffer distance from activities are currently lacking, and further research is encouraged.

Based on best available information at this time, the following measures are recommended for activity setbacks and restrictions at active Bank Swallow colonies:

- Avoid long-term use of heavy machinery in close proximity to an active colony. Ongoing normal use of existing roads is generally compatible.
- Avoid disturbances near colonies that cause strong vibrations that could result in collapse of nest burrows (Bachmann et al. 2008).
- Avoid unnecessary human presence near the colony.
- Inform all operators and other site personnel of the presence of the colony and required protection measures while it remains active.
- Cordon off the colony (if feasible) using pylons, barriers, berms of screening materials, or sand piles. These measures have been effectively employed at aggregate sites in Ontario (Cadman and Browning 2012; Ontario aggregate producers pers. comm. 2016).
- If physical barriers cannot be implemented, determine an alternate method to delineate the sensitive areas from avoidance. Such methods may require increased monitoring or repair to remain functional and intact (see Section 5).

4.1.1.3 Site Management

Additional management strategies may be used at sites to protect suitable nesting habitat. Threats to Bank Swallow habitat at pits and quarries include rapid erosion from surface water flow and loss of habitat when operations cease. The implementation of measures to address these threat mechanisms can help reduce effects on Bank Swallow.

Operation

- Surface water can cause rapid erosion; consider diverting it around existing colonies and pre-existing suitable habitat (Bachmann et al. 2008; Cadman pers. comm. 2016).
- Where gullies have been created by previous water flow and the resulting vertical faces are being used by swallows, divert additional water during the breeding season to prevent further erosion of the active colony face.

Site Closure

Once operations end, vertical bank faces supporting Bank Swallow colonies should ideally be left intact and allowed to deteriorate naturally through erosion, slumping and growth of vegetation. However, while some recommendations advocate that abandoned sand and gravel pits be left unfilled to provide habitat for Bank Swallows (e.g., Heidelberg Sand und Kies, no date), the Ontario Ministry of Labour safety requirements mandate that no vertical slopes remain upon site closure. In addition, proponents must ensure activities are compatible with the rehabilitation requirements contained within their *Aggregate Resources Act*, *1990* site plan. Rather, if regulations require removal of habitat that has been used by Bank Swallows (e.g., through flattening slopes), consider installing artificial nest structures to offer alternatives and reduce adverse effects (see Section 4.3). If impacts to a SAR cannot be avoided, an authorization or use of a regulatory exemption may be required.

4.1.2 Foraging and Roosting Habitat

Bank Swallows commonly forage over open habitats such as grassland, pasture and ponds during the breeding season (Burke pers. comm. 2016). Roosting occurs primarily in large wetlands from May to August.

- To the extent feasible, avoid operations in wetland or grassland habitats.
- Avoid use of insecticides, herbicides or fungicides in foraging and roosting habitat wherever possible. Bank Swallow presence is negatively correlated with use of herbicides (Kirk et al. 2011).

4.2 Nesting Prevention

Bank Swallows are flexible in response to changing environments and appear to readily move to new areas of suitable habitat near previously occupied sites. As a result, where avoidance of habitat is not possible, pre-planning and implementing measures to prevent Bank Swallows from establishing colonies in areas requiring disturbance during the breeding season can help prevent harm or harassment to swallows.

The measures identified in the following subsections are intended only to apply to areas of aggregate sites where Bank Swallows have not nested in previous years, and contain suitable habitat from which materials must be extracted during a particular breeding season. They are not meant to be used as general measures to prevent Bank Swallow nesting in suitable habitat outside of pits and quarries, or from within pits and quarries where opportunity for avoidance exists.

The prevention measures identified here apply only to nesting habitat (not roosting or foraging habitat). They must be implemented prior to the start of the breeding season (beginning no later than mid-April) and be maintained until at least July 15 to discourage nest burrow construction, based on the latest known date for egg laying in Ontario being July 17 (Peck and James 1987). Proponents may cease prevention measures after July 15 with the approval of local MNRF officials. If a colony becomes active despite prevention efforts, all work must stop immediately and protection measures must be implemented instead.

If prevention is required, consider simultaneously implementing habitat protection (Section 4.1) or creation (Section 4.3) measures in other areas of the site where work will not be occurring, to reduce adverse effects to suitable habitat and/or provide swallows with alternative safe nesting habitat.

4.2.1 Slope Management

Rendering habitat unsuitable for nesting (as described below) has been tested at various sites in Ontario and elsewhere. It has proven effective in preventing swallows from establishing colonies, as long as efforts are maintained throughout the season (Cadman and Browning 2012; Ontario aggregate producers pers. comm. 2016).

Bank Swallows prefer vertical slopes for nesting. If access to stockpiles or extraction faces that provide suitable nesting habitat for Bank Swallows is required during the breeding season, they should be made unsuitable for nesting by eliminating vertical faces. Sloping off stockpiles or grading and mechanically altering the slopes on extraction faces and stockpiles is the only approach considered consistently effective at deterring Bank Swallows from nesting (Bachmann et al. 2008; Cadman and Browning 2012; Landschaapsbeheer Flevoland 2014; Ontario aggregate producers pers. comm. 2016). Such sloping should be undertaken in fall, winter, or early spring.

If undertaking a slope reduction plan, consider the following recommendations:

- Reduce slopes to 70 degrees or less (Photo 4). This can be achieved by:
  - *Sloping off stockpiles (bulldozing etc.);*
  - *Using an excavator to create the desired slopes; or*
  - *Contouring faces or piling material on the face.*
- Vertical faces high up on a slope may have to be altered from above. If this is not possible, extraction in these areas may need to be scheduled for after nesting Bank Swallows have left the colony as described in Section 4.1.
- Maintain slope reduction until at least July 15; cease prevention measures between July 15 and August 20 only with the approval of local MNRF officials.
  - *For work sites that are operational daily, the slope should be left at 70 degrees or less at the end of each day.*

Photo 4: Stockpile without vertical faces. (Andy Arthur, flickr.com creative commons)

Note that any slopes or parts of slopes that are not rendered unsuitable can be occupied as quickly as overnight.

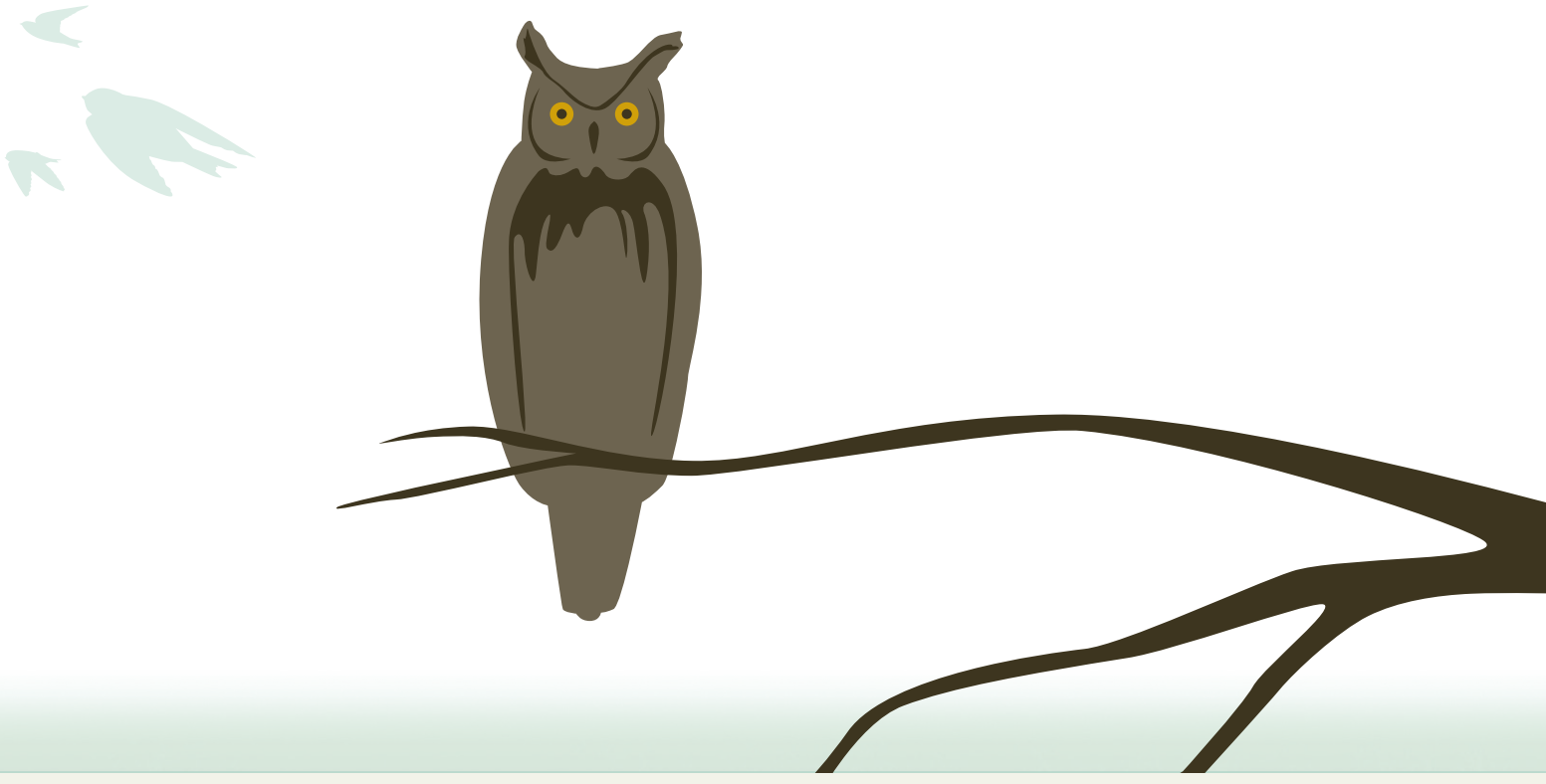
4.2.2 Deterrents and Exclusion Measures

Although slope management is the preferred approach, it may be logistically challenging or unfeasible at some sites. In these cases, other measures such as deterrents or exclusion measures may be implemented. However, it is important to note that these approaches may be less reliable than slope management.

The effectiveness of predator models to deter birds is generally considered variable and depends on the conditions under which they are used and the species involved. The best results have generally resulted from models that are most lifelike and have motion, though habituation can reduce results over time (Marsh et al. 1992). For swallows, deterrents such as hawk, owl or snake models have generally shown little or no success (Gorenzel and Salmon 1994). However, in Ontario, plastic Great Horned Owls and kites shaped as hawks have been used at select sites to deter Bank Swallows from colonizing with evidence of success at some locations (Cadman and Browning 2012, Ontario aggregate producers pers. comm. 2016). If exclusion is required and mechanical alteration is not possible, this approach may be worth implementing, as the materials are readily accessible, cost-effective and easy to install.

Exclusion methods (i.e., those that physically block access to nesting habitat) have been recommended or used in other jurisdictions (Bachmann et al. 2008), but have not yet been tested for Bank Swallows in Ontario. Further research is needed to fully evaluate the effectiveness of these prevention methods; feedback on monitoring of these or other techniques is welcome (see Section 5.3).

While acoustic deterrents such as noise-makers (i.e., boom noises in vineyards) have been used to repel some bird species, there is no evidence that they are effective against swallows (Gorenzel and Salmon 1994). They may also cause disturbance to birds beyond just the target location with potential implications under the *Migratory Birds Convention Act*, 1994. Using noise-makers to deter Bank Swallow nesting is therefore not recommended at this time.



4.2.2.1 General Considerations

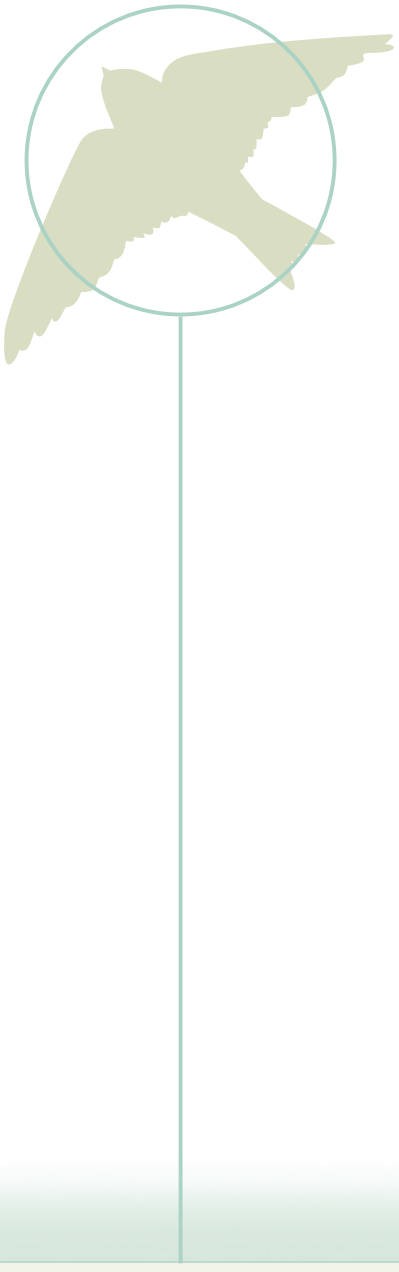
- Any deterrents should discourage Bank Swallows from nesting but not cause disturbance (i.e., harm or harassment) to Bank Swallows or other birds.
- Any deterrents or exclusion measures that are used must be installed prior to the breeding season (i.e., generally by mid- to late April) and should remain present for the duration of the breeding season.
- If the deterrent is not installed in time, or is ineffective and Bank Swallows establish a colony, all work must stop immediately in the area and protection measures (Section 4.1) rather than prevention measures must be implemented.

4.2.2.2 Exclusion Methods

- Geotextile, plastic covers, or tarping can be placed over slope faces or stockpiles undergoing industrial use to prevent nesting (Gorenzel and Salmon 1994; Bachmann et al. 2008). They should be well secured to prevent flapping in the wind or allowing access to swallows. This measure may not be logistically feasible for large sites, steep faces, or where regular access is required.
    - *Do not use mist nets or any thin, flexible net that could tangle or entrap swallows.*
- Yellow strips of fabric can be hung over the wall like a curtain to have a scarecrow effect (Bachmann et al. 2008). These should also be well secured and may need to be weighted at the bottom.

4.2.2.3 Deterrents

- One or more plastic Great Horned Owls can be installed in close proximity to habitat targeted for exclusion.
    - *The decoy(s) should be moved regularly through the breeding season to reduce the likelihood of swallows becoming habituated; this may need to be done as often as daily (Marsh et al. 1992; Cadman and Browning 2012).*



4.3 Habitat Creation

Creating nesting habitat may be desirable where activities have potential to reduce the availability or suitability of existing nesting options. Aggregate operators can assist Bank Swallows by providing nesting habitat in an area of their pits or quarries that is not intended for production during the breeding season. This can range from enhancement of existing habitat to creation of temporary (e.g., sand pile) or permanent (e.g., concrete nest wall) structures. In all cases, common factors regarding nesting habitat suitability should be considered. Foraging or roosting habitat for Bank Swallows can also be created (e.g., artificial wetlands).

In Ontario, manipulating existing substrate that is available within pits and quarries has proven to be a successful method of providing habitat that will be occupied by Bank Swallows (Cadman and Browning 2012; Ontario aggregate producers pers. comm. 2016). Where possible to implement, this is the preferred approach.

Where existing habitat is unavailable or impractical to enhance, creation of new nesting structures can be considered. This has proven highly successful in Europe (e.g., Hopkins 2001; Bachmann et al. 2008; De Azua 2012; Smeets 2013; Nottinghamshire Wildlife Trust 2016), but experience implementing artificial nesting structures in Ontario is limited. Two types of artificial structures have been piloted in Ontario (one concrete structure with sand-filled burrow tubes, and two earthen embankments). The concrete structure was unoccupied after two years and was removed, while during three years of monitoring the earthen embankments have not had confirmed nesting of Bank Swallows, although at one site two burrows were occupied by Northern Rough-winged Swallows. As a result, these measures are currently considered experimental in Ontario. It may be that in areas where other suitable nesting options exist, Bank Swallows preferentially select existing slopes over artificial structures. For example, where one earthen embankment was built, Bank Swallows nested in an adjacent pre-existing bank. Similarly, eight experimental nesting locations were created along the Sacramento River in California and were initially used, but subsequently abandoned in favour of natural habitat when maintenance stopped (Bank Swallow Technical Advisory Committee 2013).

If implementing an artificial structure, please consider sharing information on its design and effectiveness to help inform future recommendations; see Section 5.3 for guidance on monitoring and reporting results.

4.3.1 Habitat Characteristics

Although Bank Swallows readily nest in a variety of settings, numerous studies have identified factors that affect occupancy and/or nesting success. These include substrate, slope, bank size and height, orientation, and proximity to disturbance and other suitable habitat. These factors are discussed below and summarized in Table 1.

4.3.1.1 Substrate

Substrate may be the most important factor for Bank Swallows (Tozer and Richmond 2013). They prefer sand, silty sand, or loamy sand (Cadman and Browning 2012, Burke pers comm 2016). Bachmann et al. (2008) suggest that an optimal mix of sand is primarily with grains 0.063 to 2 mm in size, with 10-30% fine sand (<0.063 mm) and at most 5% gravel (>4 mm), which correlates to fine to coarse grain size in Ontario (Soil Classification Working Group 1998). Bank Swallows also readily nest in small layers of suitable sand within a matrix of coarser gravel (Cadman and Browning 2012, Burke pers comm 2016). John (1991, in Sandilands, unpubl.) noted that Bank Swallows near Ottawa, Ontario preferred mostly good quality construction-grade sands and avoided those subject to instability and rapid erosion.

Photograph of sand as an example of substrate

4.3.1.2 Slope

It is important for banks to be as close to vertical as possible and the smoother the better to limit access by terrestrial predators (LBV 2013; Heidelberg Sand und Kies, no date); unstable and slumping faces tend to not be used (Cadman and Browning 2012). Avoid overhanging faces as they are more likely to collapse (Cadman pers. comm. 2016).

4.3.1.3 Bank Size

Length

Long banks tend to support larger Bank Swallow colonies, and can experience lower rates of predation than smaller ones (Garrison 1998). In Saskatchewan, occupied banks are on average 41% longer and 29% higher than similar unoccupied habitat (Sandilands, unpubl.).

This is consistent with findings in Ontario, where Tozer and Richmond (2013) found that the probability of bank occupancy increased with bank length, with banks > 100 m long being most attractive to nesting Bank Swallows. However, Cadman (pers. comm.) notes that beyond 30 m, the relationship between bank length and colony size is weak. Where substrate is suitable, Bank Swallows excavate burrows at a density of approximately 2.5 burrows / m^2 of vertical face; a minimum of 20 m^2 is desirable to support a colony of 50 or more burrows (Cadman and Browning 2012).

Height

Colonies on river banks in California range from 0.5 to 20 m above water (Garrison 1998), while in Ontario some colonies on bluffs along Lake Erie and Lake Ontario are even higher. Various studies in Ontario, the US and Europe have suggested that Bank Swallows favour nesting in vertical banks at least 2.5-4 m above water or talus at the base of the slope (Bachmann et al. 2008; Cadman and Browning 2012, Sandilands unpubl.). Bachmann et al. (2008) note that shorter banks may sometimes be used if they are directly above water, consistent with the belief that slope height is at least partly a consideration for reducing likelihood of predation by mammals (Cadman and Browning 2012), but Hopkins (2001) recommends a minimum height of 2 m.

4.3.1.4 Orientation

In Europe, guidance for creating Bank Swallow nesting habitat commonly includes a recommendation to have nest openings face south or southeast (e.g., Heidelberg Sand und Kies, no date; Bachmann et al. 2008). However, in southern Ontario Bank Swallow colonies have been documented facing in all directions and no clear preference is apparent (Cadman and Browning 2012, Tozer and Richmond 2013). Perhaps of equal or greater importance is orienting bank faces toward foraging areas or other natural habitat, especially wetlands or other water features (Smeets 2013).

4.3.1.5 Disturbance

Where choices exist regarding location, it is preferable to create new habitat in areas likely to receive little disturbance during the breeding season. This includes avoidance of human foot traffic, heavy machinery which may cause sensory disturbance, roads which may increase the risk of mortality and heavily used recreational areas. See Section 4.1.1.2 for a review of spatial avoidance of Bank Swallow habitat.

4.3.1.6 Surrounding Habitat

If there is flexibility in location, the nature of adjacent habitat should also be considered. Nesting habitat directly above or near open water is more suitable (Hopkins 2001; Heidelberg Sand und Kies, no date) and a high proportion of colonies in Ontario are near water (Sandilands, unpubl.). There is also a positive relationship between colony occupancy and proximity of grasslands and other open habitat (Moffatt et al. 2005; Burke pers. comm.).

If creating a nest face that requires excavation for fill, consider digging in front of the wall such that a small wetland is created there (Bachmann et al. 2008), pending regulatory approval for such construction.

4.3.2 Enhancement of Existing Habitat

Where existing slopes are present, it may be possible to undertake simple measures to increase their suitability for Bank Swallow nesting. Doing so can be as basic as cutting slopes to create vertical faces (Bachmann et al. 2008), factoring in the following general considerations (see Section 4.3.1):

- If slopes are already at a suitable angle, they can be made more attractive by removing rocks and other materials at their base, reducing predator access (Bachmann et al. 2008).
- Similarly, Bank Swallows tend to avoid nesting on slopes that have shrubs or other vegetation growing on them and use of these locations can therefore be encouraged by removing such growth outside the breeding season (Heidelberg Sand und Kies, no date; LBV 2013; MacDonald pers. comm.).
- The top of the slope should also be kept clear of trees and large shrubs to prevent root growth from interfering with burrow establishment (Harder, no date), but grasses and forbs should be encouraged to reduce risk of erosion (Cadman, pers. comm. 2016).

4.3.3 Creation of New Nesting Habitat

Options for creating suitable nesting habitat can be as simple as compacting topsoil stockpiles or sand beds that are rebuilt annually, or as complex as building wood-frame or concrete walls with breeding tubes that require annual cleaning/maintenance (Heidelberg Sand und Kies, no date). Occupancy of new nesting habitat may not be immediate, but often remains high once colonized, especially for permanent structures (de Azua et al. 2012). Nest walls can sustain large colonies over an extended period. For example, a 140 m long nest wall in Bunschoten, Netherlands supported an average of 150-300 pairs over its first decade of existence (Smeets 2013). The choice of structure can be influenced by many factors, with site characteristics, program objectives and cost usually among the key considerations. Note also that success is more likely if there is suitable roosting and foraging habitat but little or no suitable habitat already available nearby.

Recommendations for Creating Bank Swallow Nesting Habitat in Pits and Quarries

Parameter: Substrate
Recommendation:
- Sand, loamy sand, or silty sand
- Seams of sand through gravel

Notes: Perhaps the most critical requirement; soils must be sufficiently firm to retain structure, but friable enough for birds to excavate burrows. Sand with a small component of coarse gravel is also acceptable.

Parameter: Slope
Recommendation: At least 75 degrees
Notes: The more vertical the better, but avoid overhanging slopes.

Parameter: Face Size
Recommendation:
- Bigger is better
- Most colonies in Ontario are at faces 10-30 m long

Notes: Bank Swallows also use smaller areas and stockpiles; the extent of the bank may not be the most limiting factor

Parameter: Face Height
Recommendation: Minimum height of 2.5 m
Notes: Height is measured above water or the upper extent of talus at the base of the bank face

Parameter: Face Shape
Recommendation: Create either a horizontal or a U-shape bank
Notes: Straight banks are more common, however U shape has been successful and uses a smaller overall amount of bank, yet provides a greater surface area for burrows.

Parameter: Face Orientation
Recommendation:
- Any direction, but consider south or southeast in the absence of other factors
- If possible, orient towards wetland or open foraging habitat (i.e., grassland)

Notes: Preference of direction appears to be variable and may be a minor consideration compared to some other factors; more study is required

Parameter: Disturbance
Recommendation: Situate in areas that will not be subject to excavation or regular use of heavy equipment
Notes: Educate site personnel regarding the presence of created (and protected) habitat

Parameter: Vegetation Management
Recommendation: Keep the base or talus clear of any tree or shrub cover, but encourage grass and forbs above slope
Notes: Grass and forb vegetation on top of the bank helps reduce rapid erosion, but vegetation below or in front of the bank facilitates predation.

Parameter: Siting
Recommendation:
- Preferable near open water or other wetland habitat
- Siting near open grassland habitat is also preferred

Notes: Success may be higher when placed in areas without existing suitable faces.

Parameter: Nesting burrows
Recommendation:
- Generally there is no need to create nesting burrows
- If providing nest holes or tubes, they should have a diameter of 10-15 cm

Notes: Use of plastic pipes or tubes has been successful at some sites in Europe, but has had limited experimentation and success to date in Ontario. Bank Swallows are usually effective at creating their own nesting burrows if suitable substrate is provided.

Parameter: Timing
Recommendation: Create habitat prior to the breeding season (generally May 1, or as early as mid-April in southwestern Ontario)
Notes: Fresh faces are preferred; if possible create these in spring, just before the breeding season

4.3.3.1 Temporary Sand Pile

A simple approach to habitat creation is a temporary sand pile. While it requires a larger volume of sand than other approaches to habitat creation, it may be easy to build within a large operation. The sand can then be reused after the breeding season as desired (Bachmann et al. 2008).

- Create piles or banks at least 2.5 to 3 m high that will be stable for at least 3 months, with a minimum slope of 75 degrees (Hjertaas 1984), while bearing in mind applicable health and safety requirements.
- If cutting an existing slope and space is limited, consider making a U-shaped indentation that will maximize the available slope face for nesting (Cadman and Browning 2012).

4.3.3.2 Framed Sand Wall

Building a framed sand wall requires some additional materials (wood and/or metal) and is more expensive than a simple sand pile, but has greater durability; this approach has been used successfully as a long linear feature, e.g., along canals (Bachmann et al. 2008) but can be applied in any setting. To date this has been attempted at one location in Ontario but was unsuccessful, perhaps due to proximity to other suitable habitat or less than optimal substrate used in the wall (Ontario aggregate producers pers. comm. 2016).

- The basic approach simply involves a structural frame at least 2.5 to 3 m high and at least 1 m deep, filled with sand and covered on top to prevent erosion, preferably sloping to the rear or with an overhanging lip to shed rain.
- A sand wall can be supplemented by embedding 1 m lengths of 10-15 cm diameter polythene pipe into the bank face to create safe and long-lasting artificial nest sites; the pipes should be at least 1 m above ground, spaced apart 40 cm vertically and 80 cm horizontally, sloping slightly up from the entrance to promote drainage and filled with sand (Hopkins 2001).

4.3.3.3 Concrete Wall

If the objective is to create long-term habitat, a concrete wall can be considered (Photo 5). While it is more expensive to build, its durability may in some settings offset the time and cost associated with creating temporary habitat annually and may be therefore be an effective option in pits or quarries that are operational for many years (Harder, no date). While one such wall has been built in Ontario to date and failed to attract any Bank Swallows over two years, the method has had considerable success in Europe.

- Concrete walls can be more effective at deterring terrestrial predators than sand slopes and eliminate risk of mortality from collapse due to heavy rain or erosion (Smeets 2013; Landschapbeheer Flevoland 2014).
- Annual maintenance is required, but is largely limited to cleaning out the nest tubes and refilling them with sand, since Bank Swallows typically excavate burrows annually and are therefore more attracted to structures with fresh sand (Bachmann et al. 2008; Landschapsbeheer Flevoland 2014).
- Harder (no date) recommends 2.5 m high concrete retaining walls, with backfill below the nest holes, topped with light loamy or clayey sand to a distance 1.5 m behind the retaining wall; the structure is ideally topped with anti-root cloth and then a layer of up to 25 cm of poor soil and a flower seed mix to encourage growth of vegetation suitable for insects, but deter shrubs and trees from establishing.
- Nest holes should be 10-15 cm in diameter and completely filled with sand (Hopkins 2001; Landschapsbeheer Flevoland 2014).
- Concrete walls can be designed so that there is walk-in access at the rear of the burrows; this is more expensive because of the additional area required and greater requirement for structural integrity, but is useful in situations where population monitoring is an objective, as nestlings can easily be accessed for measurement and banding (Bachmann et al. 2008; Nottinghamshire Wildlife Trust 2016). Rear access to nest burrows also facilitates cleaning and the potential to counter ectoparasites if warranted (de Azua et al. 2012).

4.3.3.4 Other

Other creative solutions for providing nesting structures can be explored, as long as they adhere to the general recommendations outlined above. For example, large barrels with holes bored into them and erected on posts have proven to be attractive to Bank Swallows (Sand Martins) at a site in Scotland (Hopkins 2001).

Photo 5: Artificial nest wall
(Laurence Arnold, flickr.com creative commons)

4.3.4 Foraging and Roosting Habitat

Bank Swallows use wetlands, ponds and other open areas (such as grassland and pasture) as foraging and roosting habitat. Creation of large areas of such habitat is a complex undertaking that it is largely beyond the scope of this document. However, at a local scale they can be considered in relation to creation or management of nesting colonies. This can include management of sites to promote grass and wildflowers and deter invasive plants, shrubs and trees near colonies to favour access and foraging opportunities (Garcia et al. 2008; Bank Swallow Technical Advisory Committee 2013). Such initiatives may be most effectively undertaken in partnership with organizations having expertise in design and management of artificial wetlands and grasslands (e.g., Ducks Unlimited, Nature Conservancy of Canada).

4.4 Maintenance of Habitat

Colonies benefit from maintenance of nest slopes/structures. Failure to undertake such maintenance can result in a decline in nesting habitat suitability, to the point of abandonment (Schlorff 1992).

4.4.1 Slope Management

Slope management to support nesting colonies requires maintaining suitable angles, removing vegetation, deterring predator access and in some cases replacing sand that has eroded or been excavated. The following considerations apply to slope management:

- Where swallows are using an existing slope and it is slumping, consider cutting it back in winter to create a fresh new perpendicular wall, which will encourage recolonization the following year and help prevent access by predators (Bachmann et al. 2008; Florsheim et al. 2008; Smeets 2013; Heidelberg Sand und Kies, no date).
- Erosion maintains the suitability of natural habitat and may need to be mimicked for managed colonies by cutting the slope before each breeding season to keep it steep and free of vegetation and to reduce parasite loads (Florsheim et al. 2008; Bank Swallow Technical Advisory Committee 2013; Smeets 2013).
- Keep the area in front of the nesting colony clear of tall vegetation and other obstructions to maintain an unobstructed flight path for the swallows and reduce access by predators (Hopkins 2001; Tozer and Richmond 2013).
- At pits or quarries (or sections thereof) that are inactive, maintain bare vertical slopes as long as possible (Heidelberg Sand und Kies, no date).
- Where slopes have started to grow over and other nesting options exist nearby, it can be beneficial to encourage regrowth of vegetation, to deter Bank Swallows from nesting in suboptimal conditions (Heidelberg Sand und Kies, no date).

4.4.2 Site Management

In addition to maintaining suitability of nest slopes/structures, colony attendance and success can be influenced by management of the surrounding area. See recommendations in Table 1 and section 4.3.1 for guidance on maintaining suitable conditions.

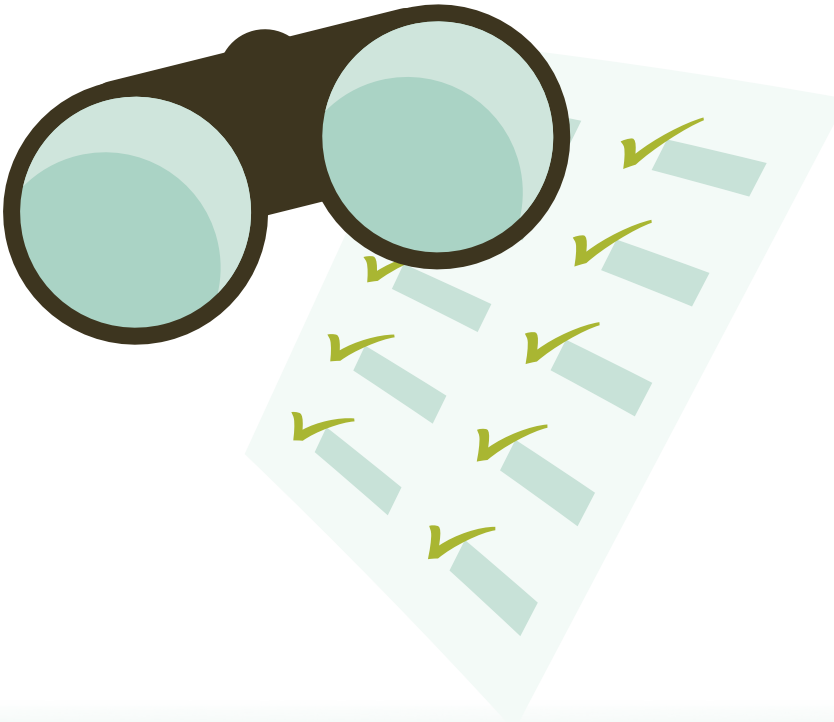
5.0 Monitoring

Monitoring is important to identify the effectiveness of best management practices. This is a requirement for aggregate proponents that have registered under the Pits and Quarries provision of Ontario regulation 242/08, Section 23.14. However, even for other parties implementing Bank Swallow management outside of the regulation, monitoring is valuable for evaluating and revising approaches to achieve optimal results.

5.1 Monitoring for Bank Swallow Presence and Activity

Effective implementation of protection measures requires awareness of the presence of Bank Swallows. A colony should be protected as soon as Bank Swallows begin to establish it (see Section 4.1). Keep dated records of when Bank Swallows arrive and depart from the site to assist with applying best management practices and complying with applicable regulations.

Although May 1 is generally considered the beginning of the breeding season in Ontario, monitoring for Bank Swallows should begin by mid-April. Surveys should be frequent (up to daily), particularly in late April and early May, as swallows begin to establish colonies immediately upon return from migration. Watch for Bank Swallows in flight and visually inspect slopes for presence of Bank Swallows (see Section 2 and Figures 1 and 2 for identification of Bank Swallows and Figure 3 for an example of a Bank Swallow colony). Note that Bank Swallows regularly leave the colony to forage and roost, therefore seeing them depart is not necessarily evidence of the colony being abandoned. Rather, a colony should be considered active until monitoring shows that no swallows have been present for at least 72 hours, recognizing that swallows may sometimes temporarily leave for 24-48 hours in response to inclement weather.



5.2 Measuring Performance of Mitigation Measures

This document is based on best available information, but the effectiveness will vary depending on local variables. It is therefore essential to monitor the effectiveness of implemented measures and take corrective actions as required to increase success. Key priorities for monitoring can include aspects of protection, prevention, creation and maintenance. Examples include:

Protection – barriers installed to prohibit access to active colonies should be checked regularly to ensure they remain intact; any missing or damaged components should be replaced and any evidence of barriers being crossed should trigger further investigation and education.

Prevention – exclusion measures that have been installed to prevent nesting in certain locations should be checked regularly to ensure they remain intact and effective. If they have not been effective and Bank Swallows have established a colony, protection measures should be implemented.

Creation – monitoring of artificial nest sites should at a minimum attempt to assess whether the site is used and if so, estimate the number of occupied burrows or number of pairs nesting in the colony annually.

Maintenance – slope angle and condition should be evaluated at least annually and adjusted outside of the breeding season if improvements are required.

Monitoring of the measures should occur throughout the breeding season, but may be particularly important after significant weather events (e.g., heavy rains, storms) to ensure they are intact and functioning as intended.

5.3 Mechanisms for Reporting

The Natural Heritage Information Centre (NHIC) maintains a record of species at risk occurrences in Ontario. All observations of Bank Swallows and active colonies can be reported to NHIC using the Rare Species Reporting Form, found at https://www.ontario.ca/form/rare-species-reporting-form. In order to submit observations you will need to provide your contact information, the date, location details (preferably a UTM location if possible) and numbers of birds observed. You can also provide additional information on the habitat, details of the observation and/or add pictures.

MNRF welcomes monitoring data regarding the success of the measures contained within this document via esapermits@ontario.ca.

5.4 Pits and Quarries Regulation Monitoring and Reporting Requirements

Aggregate proponents that have entered into the Pits and Quarries provision of Ontario Regulation 242/08 require a Mitigation Plan, including annual reports on the effectiveness of Bank Swallow management practices. The Mitigation Plan must be retained for at least five years after the activity ends and made available to the Ministry within two weeks of a request. Mitigation Plans under the Regulation must be prepared by a person with expertise in relation to Bank Swallows.

6.0 Conclusion

In Ontario, aggregate operations provide a large source of nesting habitat for Bank Swallows. This BMP document is intended to provide information to the aggregate industry and others to manage sites to reduce or avoid effects on Bank Swallows and their habitat. This BMP document is based on best available knowledge at the time of writing and should be reviewed and modified as new information becomes available.

7.0 Contacts and Links

For additional information, please refer to the following resources:

- The Ontario Ministry of Natural Resources and Forestry Species at Risk website
  https://www.ontario.ca/page/species-risk
- Ontario Natural Heritage Information Centre
  https://www.ontario.ca/page/natural-heritage-information-centre
- Ontario *Endangered Species Act, 2007*
  https://www.ontario.ca/laws/statute/07e06/v1
- Ontario Regulation 242/08
  https://www.ontario.ca/laws/regulation/080242
- Pits and Quarries Regulation Factsheet
  https://www.ontario.ca/page/pits-or-quarries-and-endangered-or-threatened-species
- Information on Bank Swallow
  https://www.ontario.ca/page/bank-swallow

You can also contact your local MNRF district or regional office:
https://www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices

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