NOVA SCOTIA

Comment Index

Spicer North Mountain Quarry Expansion Project

Publication date: March 9, 2020

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1	Kwilmu'kw Maw-Klusuaqn Negotiation Office (KMKNO)	April 8, 2020

Public

Number	Source	Date Received
1	Anonymous	March 9, 2020

Impact Assessment Agency of Canada | Agence d'évaluation d'impact du Canada

Suite 200
1801 Hollis Street
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Bureau 200
1801 rue Hollis
Halifax, NE B3J 3N4

Date: March 20, 2020

To: Renata Mageste da Silva, Environmental Assessment Officer, Nova Scotia Environment

From: Erin Norton, Environmental Assessment Officer, Impact Assessment Agency of Canada

Subject: Spicer North Mountain Quarry Expansion Project

The federal environmental assessment process is set out in the *Impact Assessment Act* (IAA). The *Physical Activities Regulations* (the Regulations) under IAA set out a list of physical activities considered to be "designated projects." For designated projects listed in the Regulations, the proponent must provide the Agency with an Initial Description of a Designated Project that includes information prescribed by applicable regulations (*Information and Management of Time Limits Regulations*).

The relevant entries in the Regulations for this type of project are:

> 18(f). The construction, operation, decommissioning and abandonment of…(f) a new stone quarry or sand or gravel pit with a production capacity of 3 500 000 t/year or more.
>
> 19(f). The expansion of an existing mine, mill, quarry or sand or gravel pit in one of the following circumstances: (f) in the case of an existing stone quarry or sand or gravel pit if the expansion would result in an increase in the area of mining operations of 50% or more and the total production capacity would be 3 500 000 t/year or more after the expansion.

Based on the information submitted to the Province of Nova Scotia on the proposed Spicer North Mountain Quarry Expansion Project, it does not appear to be described in the Regulations. Under such circumstances the proponent would not be required to submit an Initial Description of a Designated Project to the Agency. However, the proponent is advised to review the Regulations and contact the Agency if, in their view, the Regulations may apply to the proposed project.

The proponent is advised that under section 9(1) of the IAA, the Minister may, on request or on his or her own initiative, by order, designate a physical activity that is not prescribed by regulations made under paragraph 109(b) if, in his or her opinion, either the carrying out of that physical activity may cause adverse effects within federal jurisdiction or adverse direct or incidental effects, or public concerns related to those effects warrant the designation. Should the

Agency receive a request for a project to be designated, the Agency would contact the proponent with further information.

The proposed project may be subject to sections 82-91 of IAA. Section 82 requires that, for any project occurring on federal lands, the federal authority responsible for administering those lands or for exercising any power to enable the project to proceed must make a determination regarding the significance of environmental effects of the project. The Agency is not involved in this process; it is the responsibility of the federal authority to make and document this determination.

The proponent is encouraged to contact the Agency at (902) 426-0564 if it has additional information that may be relevant to the Agency or if it has any questions or concerns related to the above matters.

Thank you,

Erin Norton
Environmental Assessment Officer, Atlantic Regional Office
Impact Assessment Agency of Canada / Government of Canada
erin.norton@canada.ca /

Agente d'évaluation environnementale, région de l’Atlantique
Agence d'évaluation d’impact du Canada / Gouvernement du Canada
erin.norton@canada.ca/

From: Vervaet, Sharon <Sharon.Vervaet@novascotia.ca>
Sent: March 24, 2020 4:41 PM
To: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Cc: Seaboyer, Matt P <Matt.Seaboyer@novascotia.ca>
Subject: RE: Spicer North Mountain Quarry Expansion Project Environmental Assessment Registration

Hi Renata,
We have reviewed the air related aspects of the proposed project and have no comments. Any air quality related issues that may arise with the project should be able to be addressed within the Part V Approval.
If you have any questions, please let me know.
Regards,
Sharon

5151 Terminal Rd.
PO Box 442
Halifax, NS
B3J 2P8

Tel: (902) 424-3600
Fax: (902) 424-0503

MEMORANDUM

DATE: **March 25, 2020**

TO: **Renata Mageste da Silva**

FROM: **Neil Morehouse Manager of Protected Areas and Ecosystems**

SUBJECT: **Spicer North Mountain Quarry Expansion Environmental Assessment**

The Protected Areas and Ecosystems Branch have reviewed the Environmental Assessment Application for the Spicer Mountain Quarry Expansion

Protected Areas and Ecosystem Comments:

As there are no protected areas in the vicinity of this Quarry, no impacts to protected areas are anticipated.

Environment and Climate Change Canada | Environnement et Changement climatique Canada

Environmental Protection Branch
16th Floor Queen Square
45 Alderney Drive
Dartmouth, NS B2Y 2N6

March 31, 2020

Renata Mageste da Silva
Environmental Assessment Officer
Nova Scotia Environment
1903 Barrington St, Suite 2085
Halifax, NS B3J 2P8

Dear Renata Mageste da Silva:

RE: Spicer North Mountain Quarry Expansion Project EAS# 20-NS-004

Environment and Climate Change Canada (ECCC) has reviewed the Environmental Assessment Registration document (registered on March 09, 2020) for the above-noted project proposal and has provided the following comments:

Water Quality

Pollution prevention and control provisions of the *Fisheries Act* are administered and enforced by ECCC. Subsection 36(3) of the *Fisheries Act* prohibits "anyone from depositing or permitting the deposit of a deleterious substance of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter such water".

It is the responsibility of the proponent to ensure that activities are managed so as to prevent the release of substances deleterious to fish. In general, compliance is determined at the last point of control of the substance before it enters waters frequented by fish, or, in any place under any conditions where a substance may enter such waters.

Section 5.5.1 Surface Water Resources and Quality (Page 71) indicates water chemistry was measured at the previously monitored site in Ray Brook 15 m downstream of the access road, to maintain consistency with past monitoring efforts, but not at the site upstream of the access road, which was considered background/reference condition (page 70). Please justify not measure water quality/chemistry at a site representing reference conditions.

Canada

Section 9.1.4 Aquatic Environment, Table 37: Potential effects on the aquatic environment and proposed mitigate measures for adverse effects (page 128), states that "Adverse effects to Surface Water Resources may occur by unintended sedimentation, chemical contamination through accidental spills, vehicle accidents, or vandalism, or through unintended water quantity changes associated with landscape topographic change associated with quarry development". Are the quantities of runoff and/or concentrations of contaminants expected to remain the same?

Wildlife and Wildlife Habitat

ECCC's Canadian Wildlife Service (CWS) requests that the protective buffer around the wetland provides enough habitat to accommodate up to 5 breeding pairs of Canada Warbler, which would be a minimum of 5 ha. ECCC-CWS requests confirmation that the wetland and buffer will provide a minimum 5 ha of Canada Warbler habitat. ECCC-CWS has also attached standard guidance for the proponent on this Registration.

Migratory Birds

The *Migratory Birds Convention Act* (MBCA) protects migratory birds, their eggs, nests, and young. Migratory birds protected by the MBCA generally include all seabirds (except cormorants and pelicans), all waterfowl, all shorebirds, and most landbirds (birds with principally terrestrial life cycles). The list of species protected by the MBCA is at https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act.html. Bird species not listed may be protected under other legislation. The MBCA protects these migratory birds, their nests and eggs anywhere they are found in Canada, including ocean waters, and prohibits the dumping of substances harmful to birds in waters or areas frequented by them. Bird species not listed may be protected under other legislation.

Section 5.1 of the MBCA describes prohibitions related to depositing substances harmful to migratory birds:

- "5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

- (2) No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance – in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area - that is harmful to migratory birds."

Sections 5 and 6 of the *Migratory Birds Regulations* (MBR) describes hunting and taking of migratory birds:

- 5 (1) No person shall hunt a migratory bird except under authority of a permit therefor.

- hunt means chase, pursue, worry, follow after or on the trail of, lie in wait for, or attempt in any manner to capture, kill, injure or harass a migratory bird, whether or not the migratory bird is captured, killed or injured;

- 6 Subject to subsection 5(9), no person shall
    - disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or
    - have in his possession a live migratory bird, or a carcass, skin, nest or egg of a migratory bird except under authority of a permit therefor.

The proponent must manage their activities to ensure they are compliant with the MBCA and associated regulations.

Vegetation Clearing

Vegetation clearing may disturb migratory bird species, nests, and eggs. Birds may use trees, brush, deadfalls, low-lying vegetation, and substrates to nest, feed, and take shelter and cover. Birds may use terrestrial habitats (e.g. forests, meadows) and wetlands (e.g. marshes, fens). Clearing vegetation is most detrimental during the breeding period. This region's breeding season is generally between April 15th and August 15th. Some migratory species do nest outside of this period. Review the “Nesting Periods” (Environment and Climate Change Canada. 2018. Nesting periods. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html) and "Bird Nesting Calendar Query Tool" (Rousseu, F. and B. Drolet. 2015. Prediction of the nesting phenology of birds in Canada. In: J. Hussell and D. Lepage. 2015. Bird Nesting Calendar Query Tool. Project NestWatch. Bird Studies Canada / Études d’Oiseaux Canada. Accessed at: www.birdscanada.org/volunteer/pnw/rnest) for migratory bird breeding periods.

Recommendations:

- Avoid activities like clearing, grubbing and vegetation removal during the bird breeding season.
- Active nesting outside of regional nesting periods is possible. Be aware of signs of nesting birds during shoulder seasons.
- Install measures that will reduce the risk of impacting nests, eggs, chicks, and birds, such as:
    - establishing buffer zones around nests;
    - minimizing activities around nests until chicks have migrated from the area.
- Identify the best approach, based on circumstances, to avoid incidental take.

- While most migratory bird species nests in trees and shrubs, they may also nest on the ground and cliffs. Some birds may nest in human-influenced landscapes or infrastructure, such as:
    - hayfields, crops, orchards;
    - exposed quarry or mine dig faces, overburden piles;
    - slash piles;
    - impounded water;
    - buildings or bridges.
- Develop management plans that identify measures to avoid risks of impacting migratory birds. Management plans should include steps to follow to mitigate active nests at any time of the year. When developing plans on avoiding incidental take of migratory birds nests and eggs, please review:
    - 'Avoiding harm to migratory birds: guidelines to reduce risk to migratory birds' (Environment and Climate Change Canada. 2017. Avoiding harm to migratory birds: reducing risk to migratory birds. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html)
    - 'Avoidance Guidelines' (Environment and Climate Change Canada. 2017. Avoiding harm to migratory birds: avoidance guidelines. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/guidelines.html)
- Vegetation maintenance has to avoid incidental take of birds and nests. These activities include:
    - trimming, mowing;
    - danger tree removal;
    - weed removal and reduction.

Nest Surveys

Migratory birds can nest in a variety of habitats and locations. Depending on the species, nests may be found at many heights in trees, in tree cavities, in shrubs, on the ground (including in hayfields, crops, and pastures), on cliffs, and in burrows. Adult birds conceal nests and avoid approaching their nests in a manner that would attract predators to their eggs or young.

The amount and complexity of habitat will limit nest survey effectiveness. Few species nests are easy to locate, mainly nests in isolated trees, on human-made structures or in colonies. Flushing nesting birds increases the risk of predation of the eggs or young or may cause the adults to abandon the nest or the eggs. Therefore, except when the nests are known to be easy to locate without disturbing them, active nest searches are

generally not recommended; they have a low probability of finding all nests, and are likely to cause disturbance to nesting birds. In many circumstances, incidental take will likely still occur from industrial activities even when conducting nest searches before these activities.

To determine the likelihood that migratory birds, their nests or eggs are present in a particular location, use a scientifically sound approach that considers the available bird habitats, which migratory bird species are likely to be encountered in such habitats, and when the birds would likely be present.

Recommendations:

- In some cases, proponents may be able to carry out nest searches successfully, if:
    - They are conducted by skilled and experienced observers using appropriate methodology
    - They are searching simple habitats (often in human-made settings) with only a few likely nesting spots or a small community of migratory birds. Examples include:
        - An urban park consisting mostly of lawns with a few isolated trees;
        - A vacant lot with few possible nest sites;
        - A previously cleared area where there is a lag between clearing and construction activities (and where birds may be nested on the cleared ground or in stockpiles, for instance);
        - A structure such as a bridge, a beacon, a tower or a building (often chosen as a nesting spot by robins, swallows, phoebes, Common Nighthawks, gulls and others).
- Proponents may use nest searches when looking for:
    - Conspicuous nest structures (such as nests of Great Blue Herons, Bank Swallows, Chimney Swifts);
    - Cavity nesters in snags (such as woodpeckers, goldeneyes, nuthatches);
    - Colonial-breeding nesters that are detectable from a distance (such as a colony of terns or gulls).
- If the proponent is required to determine the presence of breeding birds, they should consider conducting an area search for evidence of nesting (e.g., presence of birds in breeding habitat through observation of singing birds, alarm calls, distraction displays) using non-intrusive search methods to prevent disturbance to migratory birds. In the case of songbirds, for example, “point counts” (a technique to locate singing territorial males) may provide a good indication of the presence of nests of these birds in an area. Please contact Environment and Climate Change Canada’s Canadian Wildlife Service office for further technical information about investigation methods for non-song bird species (notably, waterfowl, waterbirds and shorebirds).

<u>Stockpiles, Pits, and Quarries</u>

Certain species of migratory birds (e.g. Bank Swallows) may nest in unattended/vegetated soil/material stockpiles and banks in pits and quarries during the most critical period of the breeding season (April 15th through August 15th).

Recommendations:

- Install measures to cover or to deter birds from large piles of unattended soil or exposed banks/faces during the breeding season.
- Establish alternate measures to protect the nests of migratory birds that take up occupancy in piles/exposed banks. Measures should include delaying industrial activities (e.g. hydroseeding) and prevent erosion. Nests need to be protected until chicks have fledged and naturally left the area.
- Measures need to protect the entire active nesting period. This period includes when birds are incubating eggs, taking care of flightless chicks, and while chicks are learning to fly.
- Develop a mitigation plan for nesting birds. Review the following guidelines when designing mitigation measures:
    - ‘Bank swallow (*Riparia riparia*) in sandpits and quarries’ (Environment Climate Change Canada. 2017. Migratory bird conservation: publications: Bank swallow (Riparia riparia) in sandpits and quarries. Last Update: 2017-May-03. Accessed at: https://www.canada.ca/en/environment-climate-change/services/migratory-bird-conservation/publications/bank-swallow-riparia-sandpits-quarries.html);
    - ‘Bank Swallows in Pits & Quarries: Guidance for Aggregate Producers’ (Ontario Stone, Sand, & Gravel Association. 2013. Bank Swallows in Pits & Quarries: Guidance for Aggregate Producers);
    - ‘Bank Swallow (*Riparia riparia*) Know Your Legal Obligations’ (Environment Canada. 2011. Bank Swallow (Riparia riparia) Know Your Legal Obligations (CW66-297/1-2011E-PDF). Retrieved from http://publications.gc.ca/collections/collection_2011/ec/CW66-297-1-2011-eng.pdf).

Dewatering and Water Management

Migratory birds may nest in or next to water impoundments such as settling ponds or polishing ponds. Birds may also nest in areas affected by dams or near activities that alter water levels in natural reservoirs, ponds or wetlands (e.g. dewatering). Modifying water levels may impact migratory birds nests, eggs, and young:

- flooding areas;
- isolating nests;
- increasing risk of depredation;

- nest abandonment.

Recommendations:

- Determine if migratory birds are, or will likely be, nesting in or near wetlands, impounded water, or natural waterbodies.
- Avoid flooding out areas or drying up reservoirs during the breeding bird season. Wait until birds have raised their young and have dispersed from the nesting area.
- Develop management plans that identify measures to avoid risks of impacting migratory birds. Management plans should include steps to follow to mitigate active nests at any time of the year. When developing plans on avoiding incidental take of migratory birds nests and eggs, please review:
    - ‘Avoiding harm to migratory birds: guidelines to reduce risk to migratory birds’ (Environment and Climate Change Canada. 2017. Avoiding harm to migratory birds: reducing risk to migratory birds. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html)
    - 'Avoidance Guidelines' (Environment and Climate Change Canada. 2017. Avoiding harm to migratory birds: avoidance guidelines. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/guidelines.html)

Contaminant Spills, Leaks, and Releases

Contaminant leaks and spills may directly or indirectly cause incidental take if released into areas frequented by migratory birds. Biodegradable alternatives to petroleum-based chainsaw bar oil and hydraulic fluid for heavy machinery are commonly available from major manufacturers. Such biodegradable fluids should be considered for use in place of petroleum products whenever possible, as a standard for best practices.

Recommendations:

- Take all precautions to prevent fuel leaks from equipment and prepare a contingency plan in case of oil spills.
- Ensure that contractors are aware that under the MBR, “no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds.”
- Ensure that fueling and servicing of equipment do not take place within 30 meters of environmentally sensitive areas, including shorelines and wetlands.
- During site remediation, ensure that no contaminated soils are permitted to enter any water bodies frequented by migratory birds. If there is any noticeable change in numbers of any migratory bird species at the project site, contact ECCC-CWS for further advice.

- Prepare, and implement, a Spill Prevention and Response Plan, which includes:
    - mitigation measures to deter migratory birds from coming into contact with contaminants;
    - response measures to be undertaken if migratory birds or sensitive habitat becomes contaminated;
    - the type and extent of monitoring conducted during various spill events.
- Review the guidance below when preparing the plan;
    - "Birds and Oil – CWS Response Plan Guidance" (Canadian Wildlife Service. 2017. Birds and Oil - CWS Response Plan Guidance. 3 pp.)

Artificial Lights and Light Attraction

Bird collisions at lit and floodlit structures are a known problem. In Atlantic Canada, including coastal areas of New Brunswick and the Bay of Fundy, nocturnal migrants and night-flying seabirds (e.g. storm-petrels) are the birds most at risk of attraction to lights and lighting structures. Attraction to lights may result in a collision with lit structures or their support structures, or with other birds. Disoriented birds are prone to circling a light source and may deplete their energy reserves and either die of exhaustion, drop into the ocean, or drop to the ground (or a hard surface) where they are at risk of depredation.

Recommendations:

- Use the minimum amount of pilot, warning and obstruction lighting needed on tall structures. Warning lights should flash and completely turn off between flashes.
- Use the fewest number of site-illuminating lights possible in the project area. Only use strobe lights at night, at the lowest intensity and the smallest number of flashes per minute allowable by Transport Canada.
- Reduce lighting levels during severe weather events that may force migratory birds to land to prevent birds from landing in areas that would cause injury, harm, or death.
- Avoid or restrict the time of operation of exterior decorative lights such as spotlights and floodlights whose function is to highlight features of buildings or to illuminate an entire building. These lights, especially on humid, foggy or rainy nights, can draw birds from far away. Turn off these lights during the migratory season when the risk to birds is highest and during periods when birds are dispersing from their nests or colonies.
- Shield safety lighting so that the illumination shines down. Only install safety lighting where it is needed, without compromising safety.
- Shield street and parking lot lighting so that little escapes into the sky, and it falls where it is required. Consider using LED lighting fixtures as they are generally less prone to light trespass.

- The proponent should make all reasonable attempts to limit construction activities to the day and avoid illuminating the habitat adjacent to the worksite.

Noise Disturbance

Anthropogenic noise produced by construction and human activity can have multiple impacts on birds, including causing stress responses, avoidance of important habitats, changes in foraging behaviour and reproductive success, and interference with songs, calls, and communication. Activities that introduce loud or random noise into habitats with previously low levels of anthropogenic noise are particularly disruptive.

Recommendations:

- Develop mitigations for programs that introduce very loud and random noise disturbance (e.g. blasting programs) during the migratory bird breeding season.
- Prioritize construction works in areas away from natural vegetation while working during the migratory bird breeding season. Conducting loud construction works adjacent to natural vegetation should be completed outside the migratory bird breeding season.
- Keep all construction equipment and vehicles in good working order, and muffle loud machinery if possible.
- Where possible, use sound reduction technology on equipment that creates loud, intermittent, or random noise.

Revegetation, Reclamation, and Restoration

- Reseed or revegetate using a variety of species of plants native to the general project area.
- If there are no seed mixes for herbaceous native species for the area available, the proponent should ensure that plants used in revegetation efforts are not invasive.

Invasive Species

Measures to diminish the risk of introducing invasive species should be developed and implemented during all project phases.

Recommendations:

- Clean and inspect construction equipment before transport to ensure that no vegetative matter is attached to the machinery (e.g., use a pressure water hose to clean vehicles).
- Regularly inspect equipment before, during and immediately following construction in areas found to support Purple Loosestrife to ensure that vegetative matter is no transported from one construction area to another.
- Prepare a weed management strategy that would describe when and how invasive plant species will be prevented from establishing on their site/lease.

Killdeer

Killdeer (*Charadrius vociferous*) are attracted to open gravel habitats. However, Killdeer may also place nests in human-built or human-modified environments such as parking lots, recently cleared lands, and gravel pits.

Recommendations:

- Ensure project staff are aware of the potential of killdeer nests in active industrial or development areas.
- If a nest is suspected or discovered, conduct no activities around the nest that might cause the nest to be destroyed or abandoned. Activities should be suspended until the chicks have fledged and naturally left the area.

Species at Risk

Federally listed species at risk protected under the *Species at Risk Act* (SARA). The list of species protected by the SARA is on the Species at Risk Public Registry. Under S79. (1) of the SARA, “every person who is required by or under an Act of Parliament to ensure that an assessment of the environmental effects of a project is conducted, and every authority who makes a determination under paragraph 67(a) or (b) of the Canadian Environmental Assessment Act, 2012 in relation to a project, must, without delay, notify the competent minister or ministers in writing of the project if it is likely to affect a listed wildlife species or its critical habitat."

The person must also identify the adverse effects of the project on listed species and their critical habitat. The person must take measures to avoid or lessen adverse effects and that monitor for any effects caused by the project. Mitigation measures must be consistent with recovery strategies and action plans for the species.

Section 32 of the SARA describes general prohibitions related to listed wildlife species:

- 32 (1) No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species.
- 32 (2) No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species, or any part or derivative of such an individual.
- 32 (3) For the purposes of subsection (2), any animal, plant or thing that is represented to be an individual, or a part or derivative of an individual, of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species is deemed, in the absence of evidence to the contrary, to be such an individual or a part or derivative of such an individual.

Section 33 of the SARA describes general prohibitions related to the damage or destruction of residences of listed wildlife species:

- 33 No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.

The proponent must manage activities to ensure compliance with the SARA and associated regulations.

Presence of Species at Risk and Residences

Species at risk (as listed on Schedule 1 of the SARA) may occur within the study area; if the species, or it's residence, has been detected within the project area, the proponent should mitigate to avoid or minimize impacts to these individuals:

Recommendations:

- Submit observations of species at risk and their residences within the project footprint to ECCC-CWS.
- Submit any injuries, contamination, or mortality of listed species-at-risk to ECCC-CWS.
- Prepare a mitigation plan to ensure impacts to the species at risk, and it's residence, are avoided.

Bank Swallow

Bank Swallows (*Riparia riparia*) are listed as Threatened under Schedule 1 in the SARA. They are small insectivorous and highly social birds and tend to breed in a wide variety of natural habitats, but also at artificial sites with vertical banks (e.g. aggregate pits, road cuts, and stockpiles of soil). They tend to breed in colonies ranging from several pairs to a few thousand. The MBCA protects Bank Swallows, including its nests and eggs. Additionally, under the SARA, Bank Swallows have one type of residence: the occupied burrow. Therefore, any activity that damages or destroys the functions of an occupied burrow would constitute damage or destruction of the residence. These activities include, but are not limited to:

- damaging or destroying the burrow;
- blocking access to the burrow;
- changing the slope of the vertical face used for nesting;
- adding, moving or removing material from the vertical face causing the burrow to collapse or fill; or
- any other activity that would destroy the function of the burrow.

The presence of a nesting colony should be confirmed from the bottom of the vertical face, or otherwise in front of the face, as the occurrence and size of the colony can be overlooked from the top of the bank above the colony. The presence of a residence

requires one or more Bank Swallows entering or leaving a burrow, or the presence of young at the burrow entrance. Confirm burrow occupancy using the same method described above.

Recommendations:

- Be aware of the risk of nesting bank swallows in their project footprint, and educate site workers about this risk, and what constitutes a contravention of the SARA and the MBCA.
- Manage site activities to reduce the risk of bank swallows initiating a colony within their project footprint.
- Understand what constitutes an active bank swallow residence. (Government of Canada. Species at Risk Act Public Registry. Residence Descriptions. Description of residence for Bank Swallow (*Riparia riparia*) in Canada. May 2019)
- Protect bank swallow colonies that establish within their project footprint until such a time the colony is no longer active, and fledglings have naturally left the area.

Barn Swallow

Barn Swallows (*Hirundo rustica*) are listed as Threatened under Schedule 1 in the SARA. It is a medium-sized songbird and is closely associated with rural human settlements and human-built infrastructure. Barn Swallows are social throughout the year but may nest individually or in groups. Nests in small, loose colonies that usually contain no more than about ten pairs. Nests are built mainly of mud pellets. Regional surveys in the Maritimes show significant population declines over the long term. The MBCA protects Barn Swallows, including its nests and eggs, in Canada.

Additionally, under the SARA, Barn Swallows have one type of residence: the nest. Any activity that damages or destroys the functions of the nest would constitute damage or destruction of the residence. Under SARA, the nest, occupied or not, is considered a residence from May 1st or the date when the adults are first observed building or occupying the nest, whichever is earlier, to August 31st or the date when a bird is last seen at the nest, whichever is later.

Recommendations:

- Be aware of the risk of nesting barn swallows within their project footprint, and educate site workers about this risk, and what constitutes a contravention of the SARA and the MBCA.
- Understand what constitutes an occupied barn swallow residence. (Government of Canada. Species at Risk Act Public Registry. Description of Residence for Barn Swallow (*Hirundo rustica*) in Canada. May 2019).
- Protect active barn swallow nests within their project footprint until such a time the residence is no longer active, and fledglings have naturally left the area.

Common Nighthawk

Common Nighthawks (*Chordeiles minor*) are a Schedule 1 listed Threatened species under the SARA, and its nests and eggs are protected under the MBCA. Common Nighthawks may choose nest sites in open areas (e.g. gravel or sand) or cleared areas (e.g. forest harvest blocks, recently cleared land, and recent burns) in a wide range of habitats and a variety of substrates. Common Nighthawks may establish nest sites in newly cleared habitats, such as lands cleared for industrial development.

Recommendations:

- The proponent should ensure cleared areas do not have any Common Nighthawk nests.
- The proponent should survey for Common Nighthawks using standard methodology.
- The proponent will have to ensure any Common Nighthawk nests that are established in the project area are protected and that the young can fledge.

Little Brown Myotis, Northern Myotis, Tri-colored Bat

Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) are small, insectivorous bats that are listed as Endangered on Schedule 1 of the SARA. Partial identification of critical habitat has been published in the federal recovery strategy. Outside of the listed critical habitat, other habitat features such as maternity roosts are important to the maintenance and recovery of the species.

Recommendations:

- Although unlikely, if active roosts are encountered in natural or human-built structures within the project area, they should be identified, buffered, and avoided until roosting has been completed.
- Avoid causing any direct mortalities to Little Brown Myotis that choose to roost inside buildings. Little Brown Myotis may use buildings and other anthropogenic structures for roosting (particularly for maternity roosting). Do not block off access of nursing females to their pups or trap bats inside structures.
- Consult fact sheets produced by the Government of Canada about the Emergency Listing Order, the disease threatened bats, the requirements of the Species at Risk Act, and ways to protect and preserve bat populations. The factsheets are available at http://www.sararegistry.gc.ca/default.asp?lang=En&n=073DC653-1.

Accidents and Malfunctions

Hazardous materials (e.g. fuels, lubricants, hydraulic oil) and wastes (e.g. waste oil) should be managed so as to minimize the risk of chronic and/or accidental releases. For example, the proponent should encourage contractors and staff to undertake refueling and maintenance activities on level terrain, at a suitable distance from environmentally

sensitive areas including watercourses, and on a prepared impermeable surface with a collection system.

The proponent is encouraged to prepare contingency plans that reflect a consideration of potential accidents and malfunctions and that take into account site-specific conditions and sensitivities. The Canadian Standards Association publication, Emergency Preparedness and Response, CAN/CSA-Z731-03, reaffirmed 2014), is a useful reference.

All spills or leaks, such as those from machinery or storage tanks, should be promptly contained and cleaned up (sorbents and booms should be available for quick containment and recovery), and reported to the 24-hour environmental emergencies reporting system (Maritime Provinces 1-800-565-1633)

I trust the above comments will be of assistance. Please feel free to contact Michael Hingston if you have any questions or concerns.

Yours truly,

Maryam Fazeli
Environmental Assessment
Environmental Protection Operations Directorate – Atlantic

Enc: Canadian Wildlife Service 2017 Birds and Oil – CWS Response Plan Guidance
Government of Canada 2019 Description of Residence for Barn Swallow in Canada
Government of Canada 2019 Description of Residence for Bank Swallow in Canada
Ontario Stone Sand & Gravel Association 2013 Bank Swallows in Pits & Quarries Guidance for Aggregate Producers

Birds and Oil - CWS Response Plan Guidance

In all circumstances where a polluter is identified the burden of cleanup and response lies with the polluter. However, responsibility for government overview of a response to an oil spill depends on the source of the spill. The identified **lead agency** has responsibility to monitor an oil spill response and to take control if an appropriate response is not undertaken by a polluter or their agent.

Lead agency responsibilities lie with:

- **Environment and Climate Change Canada**
  - For spills and incidents on federal lands and from federal vessels.
  - Potentially for land-based incidents in waters frequented by fish.
  - May take lead if environment is not being protected by other leads, Cabinet Directive 1973.
- **Canadian Coast Guard**
  - For spills from ships.
  - All spills of unknown sources in marine environment.
- **Provincial Department of Environment**
  - For spills from land-based sources.
- **Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB)**
  - For spills related to offshore oil and gas exploration and production.
- **Transport Canada**
  - To investigate ship source and mystery spills in the marine environment.

The Canadian Wildlife Service of Environment and Climate Change Canada (ECCC-CWS) has the responsibility for licensing activities which involve the handling or disturbance of birds, and of providing advice and often direction to other agencies, responders and the polluter during oil spill incidents.

1. Hazing[1]

Purpose: Prevent birds from coming in contact with oil

Options:

- Hazing by helicopter.
- Hazing by a fast response cutter (FRC) or other watercraft.
- Release of scare devices (e.g. Breco Buoys, Phoenix Wailer).
- Use of hazing sound makers: propane cannons, whizzers, bangers, pyrotechnic devices etc.

Scare devices have a limited range of influence and likely are not a viable option with a large slick. Use of Breco Buoys and Phoenix Wailers can be used but we consider them to be largely ineffective in the situation of a large slick. Logistically, helicopter hazing would be

[1] There are several scare techniques which may be effective and do not require a permit, however a permit under the Migratory Bird Regulations **is required** for the use of aircraft or firearms (defined as capable of emitting at projectile at more than 495 feet per second). Propane cannons, blank pistols or pyrotechnical pistols firing crackers shells with **less than 495fps are legal without a permit**. Most scare tactics are relatively short lived in terms of effectiveness as birds acclimatize to the disturbance so scare techniques should be alternated to be effective.

difficult unless it was possible for a helicopter to remain on a platform offshore overnight. Hazing by FRC or other vessels would be ideal.

Short-term focused hazing by the most expedient means should be attempted to move the birds away from the slick, if logistical conditions permit. Vessels at the site should have the ability to use sound makers (propane canons, pyrotechnic devices) to disperse birds in local areas. Such equipment should be deployed immediately to these ships with trained personnel to operate them. The vessels on site should be tasked to actively search and monitor for congregations of birds which could be vulnerable to oiling. If such groups are found then attempts should be made to disperse the birds away from the oil.

2. Disperse oil

Purpose: Prevent birds from contacting oil by getting oil off the surface of the water as soon as possible.

Options:

- Dispersants.
- Mechanical dispersal with FRCs or other vessels.
- Natural dispersal by environmental conditions.

For small spills, mechanical dispersal would be the preferred method.

3. Bird Collection[2]

Purpose: Implement a humane response to oiled birds as required by Environment and Climate Change Canada's National Policy on Oiled Birds and Oiled Species at Risk.

Options:

- The only option would be a ship-based effort to detect and collect dead and live oiled birds, both within the slick and adjacent to it.

All vessels in or near the slick should understand the need to collect birds. All vessels should have dip-nets, large plastic collecting bags to hold dead birds, and cloth bags or cardboard boxes in which to hold live oiled birds. Efforts should be made to retrieve live oiled birds to ensure they are dealt with humanely.

4. Wildlife monitoring

Purpose: Determine potential impact of spill.

Options:

- Ship-based surveys for oiled and unoiled wildlife.
- Aerial surveys for oiled and unoiled wildlife. Will require structured surveys (e.g. strip or transect surveys of spill area).
- Placement of ECCC-CWS staff on vessels and aircraft.

[2] Only those individuals authorized to do so (nominee on an existing federal permit issued under the Migratory Bird Regulations) can be involved with the collection of migratory birds.

Dedicated ship-based bird surveys should be initiated immediately. Ideally arrangements should be made to have a ECCC-CWS observer on vessels or flights. In addition trained seabird observers need to be placed on all vessels monitoring a slick. This should continue until the slick is dispersed.

5. Beached Bird Surveys

Purpose: Determine impact of spill on wildlife and retrieve any live oiled wildlife on beaches.

Options:

- Conduct daily beached bird surveys during the incident and until one week after slick has been removed or dissipated.

ECCC-CWS or other government officials (CCG, Enforcement Officers) will oversee the collection of dead and live oiled birds[3] as instructed in ECCC-CWS' protocol for collecting birds during an oil spill response. This would only be required in circumstances where a large number of birds are potentially oiled or if the spill occurs in a sensitive area.

6. Drift Blocks

Purpose: Drift blocks may be deployed in slick to provide an estimate of bird mortality.

Options:

- Release from vessel.
- Release from aircraft.

The deployment of drift blocks would only be expected if there was a large spill and blocks should be released as soon as possible after a spill (ECCC-CWS should be consulted to determine protocol for drift block deployment and tracking). The polluter or their agent would be expected to ensure drift blocks are tracked and collected as appropriate.

7. Live oiled bird response[3]

Purpose: Implement a humane response to oiled birds as required by Environment and Climate Change Canada's National Policy On Oiled Birds And Oiled Species at Risk.

Options:

- Rehabilitation.
- Euthanization.

ECCC-CWS will be consulted to determine the appropriate response and treatment strategies which may include cleaning and rehabilitation or euthanization. ECCC-CWS policy specifically requires that species at risk or other species of concern be rehabilitated.

[3] Only those individuals authorized to do so (nominee on an existing federal permit issued under the Migratory Bird Regulations) can be involved with the collection of migratory birds.

Description of Residence for Bank Swallow (*Riparia riparia*) in Canada

Preface

Section 33 of the *Species at Risk Act* (SARA) prohibits damaging or destroying the residence of a listed threatened, endangered, or extirpated species. SARA defines residence as: "*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*" [s.2(1)]. With respect to a listed wildlife species that is an aquatic species or a species of bird protected under the *Migratory Birds Convention Act, 1994*, the prohibition applies wherever the residences are found. For any other listed wildlife species, the prohibition applies automatically when the residence of the species is on federal lands and will only apply on non-federal lands if an order is made pursuant to sections 34 or 35 of SARA. Under section 97 of SARA every person who contravenes section 33 of the Act commits an offence.

A residence would be considered to be damaged or destroyed if an alteration to the residence and/or its topography, structure, geology, soil conditions, vegetation, chemical composition of air/water, surface or groundwater hydrology, micro-climate, or sound environment either temporarily or permanently impairs the function(s) of the residence of one or more individuals.

The following residence description was created for the purposes of increasing public awareness, and enhancing conservation outcomes by promoting compliance with the above prohibitions.

Under SARA, Bank Swallows have one type of residence: the occupied burrow.

Under SARA, the destruction of this migratory bird species' residence is prohibited automatically on all lands. Under certain conditions, SARA provides that permits may be issued for activities that affect a listed wildlife species, its critical habitat or residences of its individuals. SARA also provides exceptions for certain activities that relate to public safety, health or national security. The Government of Canada will work with landowners and land managers to explore options when situations concerning public health and safety arise.

Damage and Destruction of the Residence

Any activity that damages or destroys the functions of the occupied burrow would constitute damage or destruction of the residence. These activities include, but are not limited to, damaging or destroying the burrow; blocking access to the burrow; changing the slope of the vertical face used for nesting; adding, moving or removing material from the vertical face causing the burrow to collapse or to be filled; or any other activity that would destroy the function of the burrow.

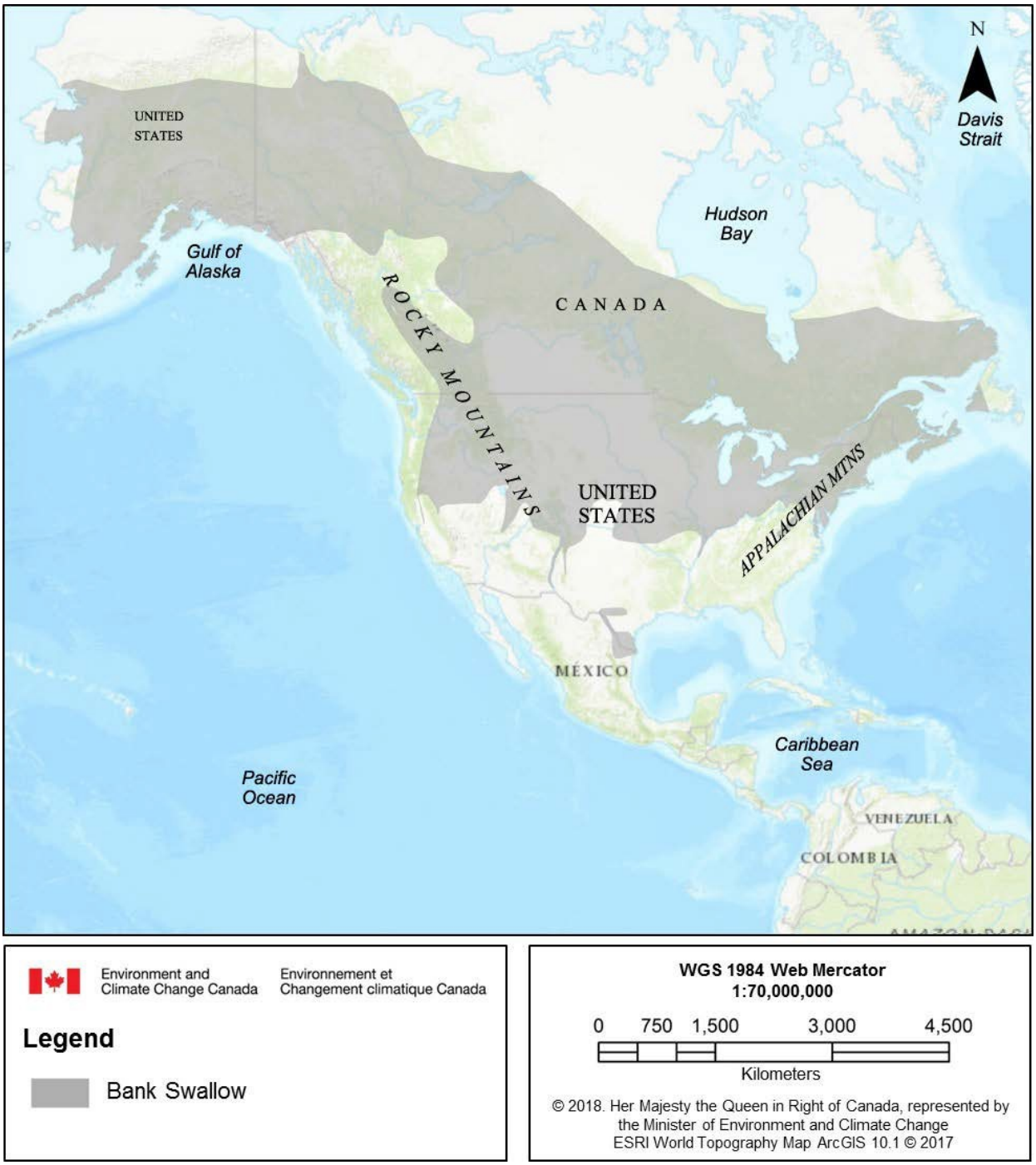

Figure 1. Known breeding distribution of the Bank Swallow (*Riparia riparia*) in North America. Note that nesting may occur outside of the currently known distribution; residences are protected wherever they occur.
Data Source: BirdLife International (2016)

1) The Burrow

Physical Appearance and Context

Any occupied[1] Bank Swallow burrow is considered a residence. The nesting burrow containing the nest is excavated by the birds parallel to ground surface and perpendicular to the bank face (Garrison 1999). The Bank Swallow builds a rudimentary nest made of grasses, feathers, twigs, rootlets, plant stalks, or leaves in a nest chamber at the end of the burrow (Campbell et al. 1997). Horizontal depth of the nest burrow averages 90 cm (range 42–180 cm) in British Columbia (Campbell et al. 1997) and 63.6 cm (range 15–145 cm) in Saskatchewan (Hjertaas 1984). In Ontario, lakeshore burrow depth averaged 71 cm (range 40 to >110 cm; n=70) and pit burrow depth averaged 65 cm (range 25 to >110 cm; n=88; Burke 2017).

In natural settings, Bank Swallows excavate burrows in near-vertical banks composed of exposed and unconsolidated silt or sand deposits (Falconer et al. 2016). Heights of banks at nesting colonies average 1.8 m (range 0.5–6.6 m) in Saskatchewan (Hjertaas 1984; Hjertaas et al. 1988). In Ontario, Bank Swallow colonies in lakeshore banks were found on vertical faces averaging 5.6 m in height (range 1.2–10.8 m; Burke 2017). On southern Ontario rivers (n=41 colonies), colony face length and height averaged 64.2 m (range 2.0–289.5) and 6.3 m (range 0.7–40.9), respectively (M. Cadman and M. Browning, pers. comm.). In Ontario pits, colony face length and height averaged 39.1 m (range 2.5–333.9) and 3.44 m (range 0.5–28.4), respectively (M. Cadman and M. Browning, pers. comm.). Nesting colonies in natural settings are generally located along rivers, streams, lakes, and ocean coasts (Garrison 1999). The location alongside waterbodies generally contributes to the natural erosion of the vertical profile, keeping the bank suitable for nesting (Garrison 1999; Falconer et al. 2016).

Burrows are aggregated into colonies of extremely variable sizes, ranging from a few nesting pairs to several thousand (Garrison 1999; COSEWIC 2013). In British Columbia, Campbell et al. (1997) reported a range of 3 to 3,035 burrows (n=491 colonies). Average size of colonies in Saskatchewan is 5 nests (range 1–48, n=79 colonies; Hjertaas 1984). Colonies along rivers in southern Ontario (n=50 colonies) averaged 100 burrows (range 1–1,256), but the median was 38 burrows (M. Cadman and M. Browning, pers. comm.). Surveys of lakeshore colonies at Lake Erie, Ontario suggest mean and median colony sizes of about 130 and 50 nests, respectively (Falconer et al. 2016). In southern Ontario, average colony size appears smaller in aggregate pit sites (112 ± 17 burrows) than at lakeshore sites (560 ± 138 burrows; Burke 2017).

The Bank Swallow often nests in human-made habitats. Burrows can be found in vertical faces in aggregate pits, along road-cuts, and in piles of sand, gravel, or sawdust (Garrison 1999; COSEWIC 2013; Falconer et al. 2016). Bank Swallows may also build nests in holes in human-made structures or occupy artificial faces

[1] Occupied is defined as the presence of one or more adult, young or viable egg.

built as surrogate habitat (Laberge and Houde 2015). Human-related excavation of material can refresh the vertical face and make banks suitable for nesting (Falconer et al. 2016).

Unoccupied burrows are typically present at active nesting colonies (Garrison 1999; Burke 2017). These burrows can remain from previous nesting seasons, result from failed excavation attempts by breeding Bank Swallow pairs, or have been abandoned by males that have not attracted a female (Garrison 1999). Mean burrow occupancy, the percentage of burrows in a colony that contain an active nest, ranges from 43 to 74% and varies annually, seasonally and by habitat characteristics (Garrison 1999; COSEWIC 2013). A recent study in Ontario (n=3205 burrows; Burke 2017) found that burrow occupancy is similar between lakeshore sites (63%) and aggregate pit sites (60%).

The presence of a nesting colony should be confirmed from the bottom of the vertical face, or otherwise in front of the face, as the occurrence and size of the colony can be easily overlooked from the top of the bank above the colony. The presence of a residence can be identified by one or more Bank Swallows entering or leaving a burrow, or the presence of young at the burrow entrance. The occupancy of a burrow can be confirmed from a single observation described above.

Function

The burrow provides thermoregulation of the eggs and nestlings, and protection against predators and harsh weather (Garrison 1999; Burke 2017). From the start of burrow excavation through the beginning of egg-laying, the burrow is used for roosting by both members of the breeding pair (Garrison 1999). The nest itself forms a rudimentary platform on which the Bank Swallow can lay and incubate its eggs and raise its chicks. In Canada, clutch size averages five eggs (range 2–7 eggs; Falconer et al. 2016); eggs are mostly incubated by females (COSEWIC 2013). Both parents feed young in the nest. Young depart the nest usually at about 18–22 days of age (Garrison 1999), but the burrows are still used for roosting for up to one week after fledging (COSEWIC 2013).

Bank Swallows are highly colonial breeders (COSEWIC 2013). Colonial nesting provides protection from predators (Burke 2017) and colonies provide an indication to the species of habitat quality (Garrison 1999; COSEWIC 2013). Large numbers of adult swallows at nesting colonies can more effectively detect, mob and deter potential predators. During post-fledging dispersal, juveniles visit multiple colonies, presumably assessing the suitability of breeding sites for future years (COSEWIC 2013).

Period and Frequency of Occupancy

In Canada, the possible period occupancy of the residence is about four months, typically from May to late August. Bank Swallows investigate many potential nesting locations, ranging over several kilometers, upon arrival on breeding grounds (Garrison 1999). Peak periods of egg-laying include the first half of June in Ontario (Peck and James 1987); in British Columbia, 55% of nests with eggs were

recorded during 14–28 June (Campbell et al. 1997). Second broods may occur in Canada, but limited evidence exists (Falconer et al. 2016).

Bank Swallows exhibit fidelity rates of 55–92% to previous nesting locations (Falconer et al. 2016). The location of colony sites might change because of the ephemeral nature of nesting habitat, while various factors can make previous nesting locations unsuitable for nesting between years. Larger colonies are more likely to be found at the same location (Freer 1977; Garrison 1999) and are more frequently reused than smaller ones. At natural sites along rivers, colonies tend to be found in the same location from year to year, although may be unoccupied some years. Adults that have successfully bred in previous years often return to the same general breeding area (Falconer et al. 2016). However, adults experiencing major nest mortality events, including predation or bank collapse, do not appear to recolonize the same nesting location, although new birds may recolonize these sites in successive years (Freer 1979; Falconer et al. 2016).

Bank Swallows typically dig new burrows each year, as erosion or human activities can cause the vertical face to collapse and expose fresh material (Garrison 1999). The burrow-excavation phase usually occurs over a period of 4–5 days, but can take longer depending on the soil type and composition (Garrison 1999). If old burrows remain, some may be reused, enlarged and deepened with excavation activities that are part of pair-bond formation. Old nests are often removed from reused burrows and new nests constructed (Garrison 1999).

Under SARA, the occupied burrow is considered a residence from the date when adults are first seen entering or leaving the burrow to the date when a bird is last seen at the burrow.

Additional Information

For more information on the Bank Swallow, go to:
https://wildlife-species.canada.ca/species-risk-registry/species/speciesDetails_e.cfm?sid=1233

For more information on SARA, go to:
https://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html

Recommended Citation

Please cite this document as:

Government of Canada. *Species at Risk Act* Public Registry. Residence Descriptions. Description of residence for Bank Swallow (*Riparia riparia*) in Canada. May 2019. (Access date).

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Acknowledgement

T. Burke (M.Sc.) and M. Cadman (Canadian Wildlife Service, Ontario) provided valuable data and comments on Bank Swallow colony monitoring in Ontario. Data from joint work between the Ontario Ministry of Natural Resources and Forestry (M. Browning) and the Canadian Wildlife Service were used in this document.

OSSGA
Essential materials for building a strong Ontario

FACT SHEET
BANK SWALLOWS (*Riparia riparia*)

Photo: John Reaume

BANK SWALLOWS in Pits & Quarries
Guidance for Aggregate Producers

With habitats around the world, the bank swallow population in Canada is in decline, with an estimated drop of over 95 per cent since 1970 in Ontario alone. While the exact reason for this decline is unknown, loss of nesting sites and young broods as a result of habitat destruction/disturbance has been cited as a possible reason.

BACKGROUND:

The bank swallow (*Riparia riparia*), can nest in colonies from 3 to about 2,000 burrows and average about 70 burrows. Sand and gravel pits often provide suitable habitats for bank swallow colonies and have become important nesting sites for this species.

The bank swallow eats flying insects and spends the winter in South America. It returns to Canada between late April and May to breed. Burrow numbers generally continue to increase until mid-to-late June and colonies often remain active until mid-August.

BANK SWALLOWS IN PITS & QUARRIES

- Bank swallows are attracted to pits and quarries. They build nests in stockpiled product or banks and they prefer sand or silty sand.
- Breeding season is early May to mid-August in southern Ontario and late-May to mid-August north of Sudbury.
- Excavation or construction during the spring and summer can negatively affect bank swallows or their nesting sites (Environment Canada, 2011).
- These birds will take advantage of stockpiled product and small banks up to large extraction faces offering suitable habitat within a pit, which has the potential to reduce operational access to these areas during the breeding season.


Photo: Mark Browning
The nest is built at the end of a burrow dug mostly by male bank swallows into a vertical bank of sand or silt, or similar material.

YOUR LEGAL RESPONSIBILITY

Bank swallows and their nests are protected under the federal M*igratory Birds Convention Act, 1994*. It is an offence for anyone to kill, hunt, capture, injure, harass, take or disturb a migratory bird nest or eggs. Offenders are liable to a fine or imprisonment. A review is currently underway to determine whether the bank swallow should be declared a species at risk in Ontario.

WHAT YOU CAN DO

- Pre-plan in March to late April (or mid-May north of Sudbury) by altering working faces and stockpiles to prevent harassment or harm to bank swallows. Manage these areas throughout the breeding season to make these potential nesting sites unattractive. See next page for details.

- Provide alternate nesting sites in an inactive portion of your pit or quarry. See next page for details.

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FACT SHEET — BANK SWALLOWS (*Riparia riparia*)

HOW TO CREATE & PROTECT HABITAT

✓**DO** set aside pre-existing suitable habitat or create new habitat in inactive area(s) of a pit or quarry before the breeding season begins by creating vertical faces of 70 degrees or more in piles or banks. These areas should be off-limits to excavation for the duration of the breeding season from May - August. Heavy machinery near colonies is likely to disturb the swallows and reduce nesting productivity.

✓**DO** cordon off these areas and inform all pit employees of the location of the colony and to avoid disturbing the colony until further notice when bird colonies are established, or suitable faces are created. This will help conserve active colonies. (Using sand piles, or pylons with or without police tape, are easy and effective ways to cordon off nesting sites.)

HOW TO DISCOURAGE BANK SWALLOWS FROM NESTING

✓**DO** discourage bank swallows from nesting in areas that will be excavated over the breeding season by contouring faces to have a less vertical slope (either by sloping off or piling material on the face to create a slope that is less than 70°). Vertical faces located high up on a slope may have to be altered from above if possible, or extraction in these areas should be scheduled for after mid-August when the birds have left.

✓**DO** install bird deterrent devices before breeding season starts, such as plastic owls (Great Horned Owls), to discourage bank swallows from establishing a colony in suitable banks.

×**DON'T** use deterrent devices (e.g. plastic owl) once a colony has been established since this could interfere with the bank swallow's ongoing nesting activities.

OTHER GENERAL CONSIDERATIONS

✓**DO** secure access to your stockpiled material throughout the season by ensuring no vertical faces remain in the stockpile. (Slopes less than 70 degrees will prevent birds from nesting.)

✓**DO** extract material ahead of the breeding season and create suitable habitat in the process by creating vertical faces greater than 70 degrees.

✓**DO** devote a few minutes to removing vertical faces at the end of the work day so that bank swallows don't begin to build in these faces overnight or over a weekend.

×**DON'T** operate heavy machinery or excavate material within 50 metres of a colony. However, moving heavy equipment past a colony once is unlikely to cause any problems.

Photo: Charles M. Francis


Photo: Robert McCaw

RESOURCES:

Environment Canada. 2011. *Bank Swallow (Riparia riparia) Know Your Legal Obligations (*CW66-297/1-2011E-PDF). Retrieved from http://publications.gc.ca/collections/collection_2011/ec/CW66-297-1-2011-eng.pdf

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DATE: April 26, 2013

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NOVA SCOTIA
Transportation and
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Environmental Services

NS Environment April 2, 2020

Attn: Renata Mageste da Silva, Environmental Assessment Officer
Nova Scotia Environment
Suite 2085 1903 Barrington St
Halifax, NS

RE: NSTIR Comments on the Spicer North Mountain Quarry Expansion Project Environmental Assessment (EA)

TIR staff have reviewed the Environmental Assessment for the Spicer North Mountain Quarry Expansion Project and prepared the following:

The proponent is proposing to expand an existing quarry, with the new quarry to be located approximately 200 m further up the access road, with the plan for the new production to replace the existing production.

The proponent has identified that there are no changes to the truck volumes anticipated, and no changes to the access road that are anticipated, and that no hazardous materials are being transported. They have also stated that there have been no significant adverse effects from the time that the quarry has been in operation.

With that in mind, the following comments are offered.

<u>Section 8 Public Engagement Summary: 8.1 Public Consultation</u>

1. The proponent has indicated in a response to a comment from the public on Page 118 that suggested that sweeping would occur at the end of the day due to potential issues with bicycles and motorbikes. The proponent has also indicated on Page 119 that normal highway travel would or should clear away any accumulated gravel at the entrance.
2. The proponent has indicated on Pg. 119 that view planes and sight lines were maintained in the past due to regular brush cutting. This should be continued as a standard practice.
3. The proponent has indicated on Pg. 119 that NSTIR may be made aware of the dirt and dust on the road surface, but that involves an assessment from their staff.

<u>Section 9.1 Potential Environmental Effects and Mitigation Measures: 9.1.6 Socio-Economic Environment</u>

1. The proponent has indicated on Pg. 134 that there have not been any **significant** adverse effects while the quarry has been in operation. Safe work practices should continue to be followed in terms of sweeping and brush cutting. Local TIR staff have not indicated this to have been a problem in the past, and since the production is indicated to remain the same, continuation of these practices, in the manner that has been identified in the report by the proponent, should not be a problem in the future.

Thank you for the opportunity to review and comment this document.

Sincerely,

Environmental Services
Nova Scotia Transportation and Infrastructure Renewal

From: d'Entremont, Adam N <Adam.dEntremont@novascotia.ca>
Sent: April 3, 2020 4:25 PM
To: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Subject: Spicer Ea

HI Renata

Attached are notes about the Spicer EA

Let me know if you have questions.

Spicer EA

Pg 9 : Refuelling of vehicles and equipment to take place on an impermeable pad

Pg 10 : When discussing area the EA and IA refer to project components differently. What I think the intent of the size of disturbed area/ quarry footprint request noted on page 10 is 4.45 ha of active area in the stockp2 quarry sites below in addition to the stockpile crusher area, road, , pollution control structures etc. This would mean about 11.45 ha (plus roads & pollution control structures) of total disturbed area.

Pg 13: The EA notes that all work will be done 1.0 m above water table. NSE quarry template now only requires 0.5m above water table .

-Water usage for dust control (while crushing, applied to roadways),

> -no indication of volume of water typically used daily. An estimate of the daily volume used during the driest times of the year would be beneficial.
>
> -water used is from a pond. Is there an alternate water supply available in case of drought.

-Expansion of stockpile area moving towards nearest off-site resident.

> -Limited information regarding impact of this change on noise levels in that direction.

NOVA SCOTIA
Environment

Adam d'Entremont, P.Eng

District Engineer

Inspection Compliance & Enforcement Division

55 Starrs Road, Unit 9

Yarmouth, NS , B5A 2T2

☎ **(902) 742-8985 or (902) 774-0868**

✉ Adam.dentremont@novascotia.ca

Please consider the environment before printing this email

NOVA SCOTIA
Environment

Barrington Place
1903 Barrington Street
Suite 2085
Halifax, Nova Scotia
Canada B3J 2P8

Date: April 6, 2020

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Wetland and Water Resource Specialist, Water Resource Management Unit

Subject: Spicer North Mountain Quarry Expansion Project: Environmental Assessment Registration- Wetlands

Scope of Review:
The following review of the Spicer Mountain Quarry Expansion Project Environmental Assessment Registration (B. Spicer Construction Limited, February 2020) is specific to the mandate of the NSE Wetlands Program within the Sustainability and Applied Sciences (SAS) Division. The review considers whether the environmental concerns associated with wetlands and the proposed mitigation measures to be applied have been adequately addressed within the Environmental Assessment.

The recommendations provided below are meant to supplement the actions outlined in the EA submission documents.

Reviewed Documents:
East Coast Aquatics Inc. 2020. *Environmental Assessment Registration of a Class I Undertaking, Pursuant to Part IV of the Environment Act, N.S. Reg 52/2005. Spicer North Mountain Quarry Expansion.* B. Spicer Construction Ltd.

Comments:
Summary of Findings:
The proponent has proposed a future quarry footprint to be located approximately 200 metres north of the existing quarry to avoid significant adverse effects to adjacent wetlands and watercourses. 8 wetlands are located within the study area. It is indicated that no wetlands will be altered directly by the proposed quarry expansion. All wetlands are at least 30 metres away from the proposed quarry footprint.

Wetland Identification:
- Wetland delineation findings and results were not included for all the wetlands. No results were included for Wetland 7 which is approximately 30 metres away from Section D of the proposed quarry development.
- No functional assessment results (WESP-AC or NovaWET) were included for Wetland 7.
- No wetland delineation and functional assessment were completed for Wetland 8, which is adjacent the access road.

Mitigation and Monitoring:

- The proponent has recognized that monitoring will be required to ensure no unpredicted significant adverse effects arise from the project, and that the magnitude of any adverse effects is as predicted.
- The proponent proposed continued/new shallow groundwater table monitoring within Wetlands 1 and 3 to establish a seasonal hydrograph for each, and continued vegetation and turbidity monitoring within Wetland 1.

Conclusions & Recommendations:

Planning/Design Issues:
It is apparent that the proponent has demonstrated avoidance in their project planning and has chosen a quarry footprint which avoids direct alteration of wetlands. The proposed quarry footprint maintains at least 30 metres distance from all 8 identified wetlands. However, there is insufficient information provided in the EA document on Wetland 7, as summarized above.

It is recommended that in addition to the proposed mitigation and monitoring as summarized above, wetland delineation, functional assessment, and groundwater table monitoring shall be completed for Wetland 7 and Wetland 8 to address any significance adverse effects that may arise from the project.

Operational Issues/Other Permitting Processes:
If, based on monitoring results, it appears that significant adverse effects have occurred from indirect wetland alteration, compensation may be required for loss of wetland area and function.

NOVA SCOTIA
Department of Business

Centennial Building
1660 Hollis Street
Suite 600
Halifax, Nova Scotia
Canada B3J 3C8

Date: April 7, 2020

To: Nova Scotia Environment

From: The Department of Business

Subject: Spicer North Mountain Quarry Expansion Project

The mandate of the Department of Business (DOB) is to lead and align provincial government efforts behind a common agenda for inclusive economic growth. This mandate focuses on strategic priorities and opportunities that encourage Nova Scotia's innovation, competitiveness, entrepreneurship, and export orientation.

Fulfilling this mandate involves working collaboratively with our Crown corporations (Develop Nova Scotia, Halifax Convention Centre Corporation (Events East Group), Innovacorp, Invest Nova Scotia, Nova Scotia Business Inc. and Tourism Nova Scotia), key partners in other levels of government, entrepreneurs, large businesses, post-secondary institutions, venture capital investors and Nova Scotians.

After reviewing the Spicer North Mountain Quarry Expansion Environmental Assessment Registration Document, the proposed project was deemed to be consistent with the mandate of the Department of Business.

Fisheries and Oceans Canada
Pêches et Océans Canada

Ecosystem Management
1 Challenger Drive
P.O. Box 1006
Station P500
Dartmouth, N.S. B2Y 4A2

Date: April 7, 2020

To: Bridget Tutty, Environmental Assessment Officer

From: Lynsey Crowell, Regulatory Review Biologist, Fish and Fish Habitat Protection Program, Ecosystem Management

Subject: Spicer Quarry Expansion Project

Dear Bridget Tutty:

Fisheries and Oceans Canada (DFO), Fish and Fish Habitat Protection Program (FFHPP) received the Nova Scotia Environmental Assessment registration document submitted for the Spicer Quarry Expansion Project in Annapolis County. The project is to expand on an existing quarry that is currently under 4ha to 7.04 ha plus an associated 2.5 ha expansion of the stockpile/crusher area. Quarry operations are anticipated to remain the same.

The study area is comprised of a long parcel of land on the south side of the North Mountain in the Bridgetown area of Annapolis County. Ray Brook is located to the Southwest of the proposed expansion and runs along the existing quarry footprint and under a road next to the crusher area. Immediately upstream of the road crossing the confluence of two Ray Brook's branches occurs. There are also two tributaries to Ray Brook that begin on the site from the outlets of wetland 1 and 3 towards the headwaters of the watershed.

DFO-FFHPP is responsible for administrating the fisheries protection provisions of the *Fisheries Act* (FA) and the *Species at Risk Act* (SARA) for aquatic species at risk. The fisheries protection provisions of the FA includes section 35 which prohibits the harmful alteration, disruption, or destruction (HADD) of fish habitat and section 34.4 which prohibits the death of fish by means other than fishing. SARA prohibits the killing, harming, harassment, possession, capturing or taking of a species listed as extirpated, endangered or threatened; the damage or destruction of a residence or the destruction of any part of the critical habitat of such a listed species, unless authorized by the minister.

Below you will find the comments from DFO - FFHPP regarding the above mentioned project:

- The proponent has sited the expansion area to reduce the potential impacts on

nearby wetlands and watercourses. The proponent has indicated that a 30m or larger buffer zone will remain between quarry activities and the nearby wetland and watercourses.

- A 100m buffer zone is proposed to remain between the expansion area and the upstream wetland 3, to reduce the potential for indirect impacts of blasting on the water table.

- Field work was completed in June with Brook trout and American Eel found in Ray Brook, with the fish found at lower elevations within the watercourse. No fish were found at the outlets of wetland 1 and 3.

- Any indirect impacts associated with the quarry expansion that may result in either the reduction or increase in surface water flow to nearby wetlands or watercourses could result in the requirement for a FA authorization from DFO.

- The current project design has limited erosion and sedimentation control plans. A more detailed engineered design should be submitted, by a qualified professional engineer licensed to practice in Nova Scotia. It was noted in the submission that sediment from anthropogenic sources was found in Ray Brook. A more detailed review should be completed at the site to ensure current erosion and sedimentation control measures are sufficient to prevent HADD.

- It was also reported, that TSS was exceeded in March 2019 where the difference between upstream and downstream TSS values exceed 25mg/L. The maximum increase of TSS has been exceeded 3 times over the last 8 years. The average increase in TSS from the upstream background sample location to the downstream sample location has been 20.7 mg/L. No mitigation measures were reported in the submission. Note, that under section 36(3) of the FA, no person shall deposit or permit the deposit of deleterious substance in any water frequented by fish or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.

BLASTING

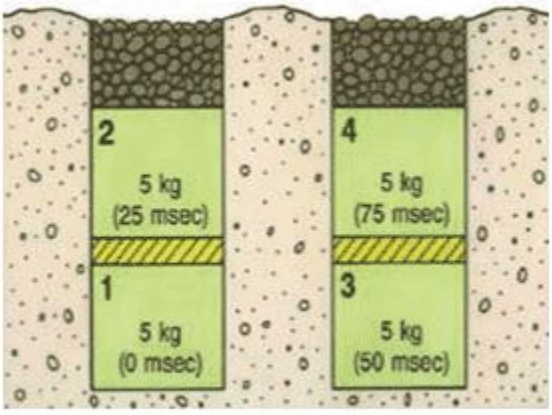
- Avoid using explosives in or near water. Use of explosives in or near water produces shock waves that can damage a fish swim bladder and rupture internal organs. Blasting vibrations may also kill or damage fish eggs or larvae.

- If explosives are required as part of a project (e.g., removal of structures such as piers, pilings, footings; removal of obstructions such as beaver dams; or preparation of a river or lake bottom for installation of a structure such as a dam or water intake), the potential for impacts to fish and fish habitat should be minimized by implementing the following measures:

    - Time in-water work requiring the use of explosives to prevent disruption of vulnerable fish life stages, including eggs and larvae, by adhering to appropriate fisheries timing windows.

- Isolate the work site to exclude fish from within the blast area by using, for example, bubble/air curtains (i.e., a column of bubbled water extending from the substrate to the water surface as generated by forcing large volumes of air through a perforated pipe/hose), cofferdams or aquadams.
- Remove any fish trapped within the isolated area and release unharmed beyond the blast area prior to initiating blasting
- Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes (i.e., decking) with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations (see Figure 1).
- Back-fill blast holes (stemmed) with sand or gravel to grade or to streambed/water interface to confine the blast.
- Place blasting mats over top of holes to minimize scattering of blast debris around the area.
- Do not use ammonium nitrate based explosives in or near water due to the production of toxic by-products.
- Remove all blasting debris and other associated equipment/products from the blast area.

Figure 1: sample blasting arrangement



Per Fig. 1: 20 kg total weight of charge; 25 msecs delay between charges and blast holes; and decking of charges within holes.

Health Canada Santé Canada

Environmental Health Program
Regulatory Operations and Regions Branch
1505 Barrington Street, Suite 1817
Halifax, NS B3J 3Y6

April 7th, 2020

Renata Mageste da Silva
Environmental Assessment Officer
Nova Scotia Environment
Suite 2085 1903 Barrington St
Halifax, NS

Subject: Health Canada's Response – Spicer Mountain Quarry Expansion Environmental Assessment Registration Document[1]

Dear Ms. Mageste da Silva:

Thank you for your e-mail dated March 1st, 2020, requesting Health Canada's review of the above-mentioned Environmental Assessment (EA) Registration document[1] with respect to issues of relevance to human health. Health Canada has reviewed the document and is providing the following information with respect to receptor location(s), noise, air quality, water quality and country foods for your consideration.

Project Location and Characteristics:

The proposed project is an 10 ha expansion of an existing quarry, referred to as the Spicer Mountain Quarry, 2.7 km northwest of the community of Upper Granville, and approximately 3 km north of Tupperville. The civic address of the quarry is 7297 Highway 1, Upper Granville, Annapolis County. The expansion proposes to operate over the next 30 years. With anticipated future operations involving the extraction of approximately 100,000 to 150,000 tonnes/year.

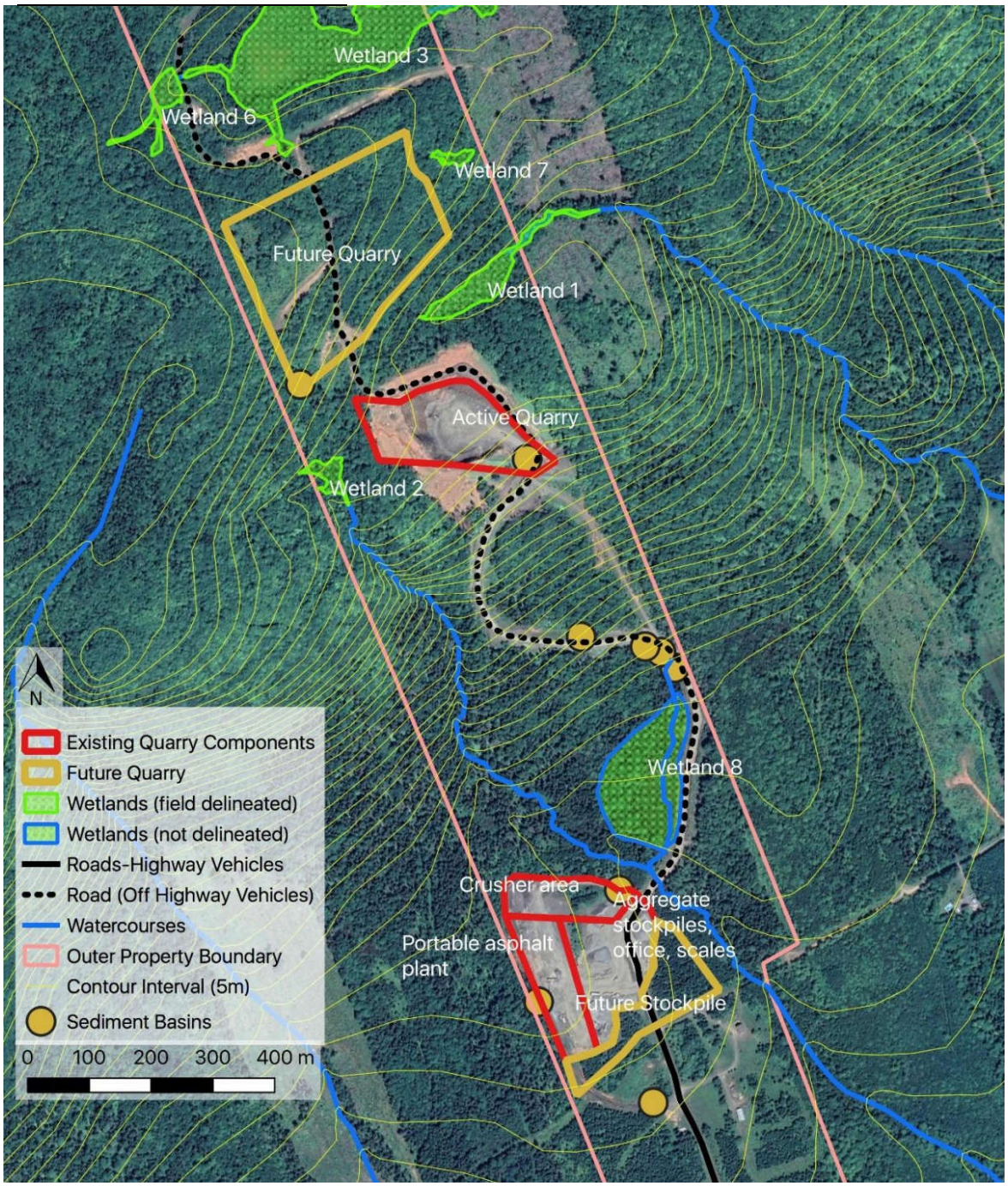
Receptor Location(s):

According to the report the closest residential receptor is the proponent's house, with the nearest offsite residential receptor being 1100 m from the existing quarry, 1300 m from the proposed quarry, and 420 m from the stockpile/crusher area. As shown below a farm or multi structure home development (receptor 1) is located approximately 415m east of the quarry development area (QDA).

[1] East Coast Aquatic Inc. Environmental Assessment Registration for the Spicer Mountain Quarry Expansion. Prepared on behalf of Spicer Construction Ltd.. 2020. March

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

The study area includes both the existing quarry area, the expansion and the crusher area known as the (QDA). This is shown in Figure 3 in the report (below).



Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

The study area including the crusher and future stockpile area is shown relative to receptor 1 in the Figure (below).

Figure 2: Future Stockpiled and Nearest Home

- It is important to clearly describe the location and distance from the project site(s) of all potential human receptors (permanent, seasonal or temporary)—taking into consideration the different types of land uses (e.g. residential, recreational, industrial, etc.); and identifying all sensitive people (e.g. in schools, hospitals, retirement complexes or assisted care homes). Note that the types of residents and visitors in a particular area will depend on land use, and may include members of the general public and/or members of specific population subgroups (Indigenous peoples, campers, hunters, etc.)

Further, Section 8.2 states:

> *"A Project Description and invitation to the May 13, 2019 Information Session was sent on April 13th to First Nations' communities which may have an interest in the project (Bear River FN, Annapolis Valley FN, Millbrook FN, Sipekne'katik FN and the Native Council of Nova Scotia. Project Descriptions and letters were also sent to the NS Office of Aboriginal Affairs (NS OAA) and the Kwilmu'kw Maw-klusuaqn (KMKNO) (the Mi'kmaq Rights Initiative). No responses were received by the time of producing this report"*

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

Section 8.2 discusses the stakeholder engagement. Although early engagement was initiated with the nearest First Nations (through provision of the Project Description and an invite to the Information Session), meetings with the nearest Mi'kmaq Community bands have not yet occurred. Meetings with Office of Aboriginal Affairs and Native Council of Nova Scotia have occurred.

- If future Mi'kmaq engagement occurs and human health issues are identified, these additional concerns may need to be addressed and additional mitigation may be required.

Noise:

Noise can be created from multiple quarry sources including the use of heavy equipment, hauling of material by trucks, quarry processing equipment, and the asphalt plant. Crushing and quarry rock trucking are the primary sources of noise and vibration that can act as a nuisance for adjacent residents.

Blasting:

Section 2.3.3 notes, *"Quarrying and processing of rock (excavation, crushing, stockpiling) occurs from 06:00 to 19:00, Monday to Friday, for approximately nine months per year (April to December). Hauling of gravel and aggregate from the site occurs on the same daily and weekly hours, for approximately ten months per year."*

The EA report states there are no anticipated changes to blasting frequency, with a maximum of 2 to 3 days of blasting per year, however, if the frequency of blasting does increase and public concerns arise, there may be need for further mitigation measures to be employed.

Crushing:

> Section 2.3.5 states: *"Noise levels have been measured during crushing operations at the current and future stockpile/crushing area at the base of the north mountain. NSE Inspector Specialist Jacquelyn Burneau conducted a sound test near the closest residential receptor and found acceptable sound levels (K. Spicer pers. comm. 2020). The receptor was a Spicer owned resident on the subject properties immediately south of Beaconsfield Road, approximately 175m from the existing stockpile/crusher area footprint."*

- Section 8.2 indicated a neighboring receptor had issues with crushing noise and dust and noted noises begun as early as 6 am. The receptor on Beaconsfield Road, which is 415m from the QDA, would likely be receptor most sensitive to crushing noise in early mornings. If public concerns arise related to crushing noise, there may be need for further mitigation measures.

Truck traffic:

Table 33. Stakeholder Engagement Summary stated multiple local residents are concerned with the

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

noise from existing and future truck traffic in the neighbourhood.

The EA notes that truck traffic likely won't change as a result of the expansion, however Section 2.3.3 states that

> *"Vehicles hauling aggregate from the Spicer North Mountain Quarry to off site project locations include both trucks owned and operated by B. Spicer Construction Ltd. as well as those operated by private third-party construction contractors. All vehicles enter and leave the site via the 2.2 km private gravel access road linking Highway 1 to the stockpile area. With the proposed increase in size of the stockpile area, on site transport and crushing activities will be kept physically separated from on highway trucks. Trucks are loaded with required aggregate and scaled in the stockpile area before leaving to Highway 1 where they will travel either east or west to markets. Majority of production is used within a 50 km radius of the quarry, with occasional trips 70 km in length. At current production levels, during peak production periods, approximately 50 trucks leave the site per day (3% of Highway 1 volume), with approximately 10 truck departures per day during off peak periods."*

- If truck traffic does increase as a result of the expansion, there may be need further mitigation measures as there is existing public concern about truck traffic. Due to the proximity between receptors and the truck traffic, noise may become a concern if traffic noise reaches the neighbouring properties.

For a detailed description of Health Canada's guidance for evaluating noise in EAs, please see the attachment.

Health Canada. 2016. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Air Quality:

Section 2.3.4 states monitoring of airborne particulate emissions will be conducted at the request of NSE and in accordance with the *Pit and Quarry Guidelines and the Nova Scotia Air Quality Regulations*.

- Due to the proximity between (receptor 1) and the crushing plant and asphalt plant, air quality may become a concern if dust reaches the nearest neighbouring properties. If actual particulate levels exceed the *Nova Scotia Pit and Quarry Guidelines*[2] at the nearest residence, particulate monitoring and/or additional mitigation may be required, particularly in the event of public complaints.

Table 33 indicates the greatest concern raised by multiple local residents, was in relation to existing

[2] *Nova Scotia Environment. Pit and Quarry Guidelines. Revised 1999.*

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

and future truck traffic in the neighbourhood. Their concern related to truck traffic dust and noise.

- As discussed above, if truck traffic does increase and there are public complaints about resulting dust, further mitigation may be required.

The quarry will operate a mobile asphalt plant. Monitoring, discussed in Section 2.3 states that dust and particulate matter will be monitored at the property boundary of the quarry, but does not discuss monitoring of NOx, SO2, CO, (PAHs) or (VOCs). Further, the mitigation measures only discuss mitigation of dust, therefore it may be necessary to monitor other air pollutants and develop mitigation if there are public complaints connected to the asphalt plant.

For a detailed description of Health Canada's guidance for evaluating air quality in EAs, please see the attachment.

Health Canada. 2016. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Air. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Water Quality:

The use of ammonium nitrate in the blasting process has the potential to leave residual nitrogen that can leach into groundwater. Processing of aggregate and rock at a quarry (notably crushing and exposure of rock to water and oxygen), can create dissolved solids and metals which could potentially make their way to water wells or surface water features.

Section 6.3.3 states:

> *"Annual groundwater monitoring has been conducted at the Spicer North Mountain Quarry by E&Q Consulting, on behalf of the proponent, for the period of 2013 to 2018. Annual summaries of this monitoring have been regularly reported to NSE (E&Q Consulting, 2013 to 2018) as condition of the existing Industrial Approval for the existing quarry ."*

It was noted in the report that Toluene, Iron and Manganese was slightly elevated in Well 2. It was also noted that neighboring receptors requested their well to be monitored during the information session, but that proposal was rejected by the proponent. The location of the nearest (off property) well in relation to the project, is unknown, if the well is within 500m of the QDA it could be interesting to know the parameters of their drinking water before expanding the project.

- If the nearest onsite potable wells are impacted as a result of the project, baseline sampling of these wells for quantity and bacteriological and chemical quality may be necessary.

Country Foods:

Section 6.1 states:

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

"the Archaeology Research Division at Kwilmu'kw Maw-klusuaqn (KMKNO-ARD) note that one traditional use site occurs within a one-kilometre radius of the Spicer Quarry study area. This is an unspecified hunting site. Bear River reserve is the nearest present day First Nations community to the study area and lies approximately 34.5 km to the southwest"

- There is no discussion in the document concerning the potential for contamination of the country foods harvested in the area. There is a hunting area within 1 km of the quarry, the exact location is not known. If known, it may be beneficial to provide information on the consumption of country foods in the area.

For a detailed description of Health Canada's guidance for evaluating country foods in EAs, please see the attachment.

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Country Foods. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

If you have any comments/questions, please contact the undersigned at your convenience.

Sincerely,

Lance Richardson-Prager
Health and Environment Specialist
Health Canada, Atlantic Region

e-mail: lance.richardson-prager@canada.ca

Attachments:

Health Canada. 2016. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Air. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Health Canada. 2016. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

Assessment: Country Foods. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Water Quality. Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Sent by e-mail to
Renata.MagestedaSilva@novascotia.ca

NOVA SCOTIA
Communities, Culture and Heritage

1741 Brunswick Street
3rd Floor
P.O. Box 456
Halifax, NS
B3J 2R5

Date: April 7, 2020

To: Renata Mageste da Silva, Nova Scotia Environment

From: Acting Coordinator Special Places, Culture and Heritage Development

Subject: Spicer North Mountain Quarry Expansion

Staff of the Department of Communities, Culture and Heritage has reviewed the Spicer North Mountain Quarry Expansion EA documents and have provided the following comments:

Archaeology

Staff reviewed the sections of the EA document pertaining to archaeology and have no archaeological concerns. The archaeology sections within the document align with the results and recommendations highlighted in the Archaeological Resource Impact Assessment report for the project area completed by Davis MacIntyre and Associates.

Botany

Staff reviewed the sections of the EA document pertaining to botany and provided the following comments:

The consideration of climate change impacts and mitigation is generally excellent, but the proponents should also clearly articulate any relevant procedures for limiting greenhouse gas emissions, such as no-idle policies, the use of alternative or lower-carbon energy sources, etc.

The plan includes monitoring of air and water quality to track possible negative impacts but does not state how air quality & dust monitoring stations will be distributed; rather, it proposes to leave such decisions to regulatory agencies. However, it would be in the best interest of both the company and the local ecosystems to ensure such monitoring can separate the impacts of the quarry (e.g., on the SOCI plants and lichens in wetland 3) from the impacts of the adjacent gravel road that continues northwards on North Mountain. Because the road is much closer to wetland 3 and is upslope from it, whereas the proposed new quarry is on the other side of the hill, negative impacts (e.g., dust and erosion) are much more likely from the road, and these could be falsely attributed to the quarry if monitoring is not adequately spatially distributed. If it is feasible to include monitoring of air quality (e.g., using a lichen ladder method or more

sophisticated equipment) in or near wetland 3, as well as at the northern edge of the proposed new quarry, it would assist land managers with understanding the source of potential negative impacts in the future, thereby facilitating the mitigation of those impacts as they are detected.

Palaeontology

Staff have reviewed the sections of the EA document pertaining to palaeontology and geology. The quarry is focused on North Mountain basalt igneous bedrock that would not contain any fossils. If any sedimentary units were located during new quarry operations, these may represent fissure fills and it would be helpful to have a palaeontologist or museum representative examine the site. In general though, the likelihood of encountering fossil material in the quarry area during this operation is extremely low to nill. The expanded stockpile area is located in an area where the bedrock geology is the Blomidon Formation sandstones. The likelihood of disturbing fossil material is low - but if significant amounts of Blomidon Formation bedrock are exposed during development of the expanded stockpile area, it may be desirable to have a palaeontologist examine the site for potential fossils.

Zoology

No CCH staff were available to review the sections relating to zoology.

NOVA SCOTIA

Agriculture

60 Research Drive
Suite A
Bible Hill, Nova Scotia
B6L 2R2

Date: April 8, 2020

To: Renata Mageste da Silva, Nova Scotia Environment

From: Executive Director, Policy and Corporate Services,
Nova Scotia Department of Agriculture

Subject: Spicer North Mountain Quarry Expansion – Environmental Assessment

Thank you for the opportunity to review the Spicer North Mountain Quarry Expansion documents.

The Nova Scotia Department of Agriculture has no immediate concerns with the proposal.

NOVA SCOTIA

Fisheries and Aquaculture

60 Research Drive
Suite A
Bible Hill, Nova Scotia
B6L 2R2

Date: April 8, 2020

To: Renata Mageste da Silva, Nova Scotia Environment

From: Executive Director, Policy and Corporate Services
Nova Scotia Department of Fisheries and Aquaculture

Subject: Spicer North Mountain Quarry Expansion - Environmental Assessment

Thank you for the opportunity to review the Spicer North Mountain Quarry Expansion Project documents.

The Nova Scotia Department of Fisheries and Aquaculture has identified the following:

- There is one issued land-based aquaculture licence, three issued marine shellfish licenses, one proposed experimental marine shellfish license and seven processing plants in the local area of the proposed quarry. Potential impacts to these operations should be considered in the expansion.

- Statements made in the document on page 89 may not be an accurate representation of the age of maturity in streams in that area. High gradient, low nutrient streams like this one, often display smaller length at maturity characteristics than typical mainland (lower gradient, higher nutrient) brook trout populations.

  The following study on North Mountain streams is likely a more appropriate reference for age structure and also suggests that some are probably reproductive: *Ruzzante DE, McCracken GR, Parmelee S, Hill K, Corrigan A, MacMillan J, Walde SJ. 2016 Effective number of breeders, effective population size and their relationship with census size in an iteroparous species, Salvelinus fontinalis. Proc. R. Soc. B 283: 20152601.http://dx.doi.org/10.1098/rspb.2015.260)*

- The proposed recommendations listed throughout the report address fish or fish habitat considerations.

PROCEEDINGS B

rspb.royalsocietypublishing.org

Research

Cite this article: Ruzzante DE, McCracken GR, Parmelee S, Hill K, Corrigan A, MacMillan J, Walde SJ. 2016 Effective number of breeders, effective population size and their relationship with census size in an iteroparous species, *Salvelinus fontinalis*. *Proc. R. Soc. B* **283**: 20152601.
http://dx.doi.org/10.1098/rspb.2015.2601

Received: 30 October 2015
Accepted: 7 January 2016

Subject Areas:
ecology, evolution, genomics

Keywords:
N_b, N_e, small populations, iteroparity, brook trout, age at maturation

Author for correspondence:
Daniel E. Ruzzante
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Electronic supplementary material is available at http://dx.doi.org/10.1098/rspb.2015.2601 or via http://rspb.royalsocietypublishing.org.

THE ROYAL SOCIETY PUBLISHING

Effective number of breeders, effective population size and their relationship with census size in an iteroparous species, *Salvelinus fontinalis*

Daniel E. Ruzzante[1], Gregory R. McCracken[1], Samantha Parmelee[1], Kristen Hill[1], Amelia Corrigan[2], John MacMillan[2] and Sandra J. Walde[1]

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The relationship between the effective number of breeders (N_b) and the generational effective size (N_e) has rarely been examined empirically in species with overlapping generations and iteroparity. Based on a suite of 11 microsatellite markers, we examine the relationship between N_b, N_e and census population size (N_c) in 14 brook trout (*Salvelinus fontinalis*) populations inhabiting 12 small streams in Nova Scotia and sampled at least twice between 2009 and 2015. Unbiased estimates of N_b obtained with individuals of a single cohort, adjusted on the basis of age at first maturation (α) and adult lifespan (AL), were from 1.66 to 0.24 times the average estimates of N_e obtained with random samples of individuals of mixed ages (i.e. $\hat{N}_{b(adj2)}/\text{mean}(\hat{N}_{e(\text{mixed ages})})$). In turn, these differences led to adjusted N_e estimates that were from nearly five to 0.7 times the estimates derived from mixed-aged individuals. These differences translate into the same range of variation in the ratio of effective to census population size ($\hat{N}_{e(adj2)}/\hat{N}_c$) within populations. Adopting $\hat{N}_{e(adj2)}$ as the more precise and unbiased estimates, we found that these brook trout populations differ markedly in their effective to census population sizes (range approx. 0.3 to approx. 0.01). Using AgeNe, we then showed that the variance in reproductive success or reproductive skew varied among populations by a factor of 40, from $V_k/k \approx 5$ to 200. These results suggest wide differences in population dynamics, probably resulting from differences in productivity affecting the intensity of competition for access to mates or redds, and thus reproductive skew. Understanding the relationship between N_e, N_b and N_c, and how these relate to population dynamics and fluctuations in population size, are important for the design of robust conservation strategies in small populations with overlapping generations and iteroparity.

1. Introduction

The genetically effective size of a population (N_e) is the size of an ideal population that loses genetic diversity at the same rate as the actual population under study [1,2]. Effective size influences both the rate of random genetic drift and the effectiveness of natural selection acting on the population, and is thus a fundamental concept in evolutionary genetics. Because wild populations usually depart from ideal conditions, effective population sizes are generally smaller than the corresponding census population sizes [3,4], but how much smaller remains uncertain [5]. The uncertainty is in part due to the fact that effective population size is notoriously difficult to estimate precisely and without bias. One important source of bias arises from the use of estimation methods that assume discrete generations for species and populations that actually have overlapping generations and iteroparous reproduction [6]. Analysis of individuals belonging to a single cohort (using the extent of linkage disequilibrium (LD))

can provide estimates of the annual effective size or the number of effective breeders ($\hat{N}_b$) in the parental generation (i.e. the generation that gave rise to that particular cohort). Generational $\hat{N}_e$ has traditionally been approximated as the product $\hat{N}_b \times G$ (G: generation length) [7,8]. However, this estimation has recently been shown to be problematic if applied to iteroparous species, with estimates of $\hat{N}_b$ sometimes exceeding N_e [9]. Fortunately, the actual ratio of $\hat{N}_e$ to $\hat{N}_b$ can be predicted if several simple life-history traits are known: age at maturation, adult lifespan (AL) or number of reproductive cycles and variance among breeders in reproductive success [9,10] (and see [6]). Using the empirical quantitative relationships described by Waples *et al.* [10], it is now possible to obtain unbiased estimates of N_b or N_e for iteroparous species from single cohort estimates of N_b based on LD. Our goal in this study is to examine the relationship between census population size and these two measures of effective size, N_e and N_b for 14 small populations of brook trout (*Salvelinus fontinalis*). We compare biased and unbiased estimates for each of the populations and explore reasons for the variation in the relationship among populations.

Stream fish populations are often used for landscape genetics studies as the linear nature of stream habitats can lead to the simplification of genetic models used to understand their evolutionary dynamics [11–14]. Resident salmonid populations inhabiting small streams generally exhibit relatively short generation times, facilitating the study of the relationship between effective and census population sizes. Recent studies have produced variable estimates of N_b/N_c for stream brook trout populations, with large differences among studies as well as among populations within studies in these ratios [15–17]. The differences have been linked to differences in habitat variability and habitat quality, which in turn result in differences in census population size and potentially also in life-history traits such as age and size at maturation, and age-specific survival or reproductive lifespan [15,17]. None of these studies, however, considered the extent to which biases in the estimates of N_e stemming from the use of models developed for semelparous species might have influenced their estimates, nor whether variation in such biases among populations might account for some of the among population variation observed in their systems.

In this study, we first describe the structure of 14 brook trout (*S. fontinalis*) populations inhabiting 12 independent streams in eastern Canada and estimate their level of connectivity. The streams are small (maximum 5 km in length), and are located in independent and parallel watersheds that empty into the Bay of Fundy along the northwest shore of Nova Scotia. Some of the populations are landlocked owing to coastal or upstream waterfalls, and the others have intermittent connectivity to the sea during high water events. Although anadromy and interdrainage migration is in principle possible for these populations, we find that all 14 populations are essentially isolated.

For each population, we then estimate effective size using a variety of methods and census size. We then assess the extent of estimate bias when using methodology that assumes semelparity by examining the relationship between $\hat{N}_b$, $\hat{N}_e$ and census population size $\hat{N}_c$ for adjusted and non-adjusted estimates of N_e. We find that the ratio of the effective population size estimated with a sample of mixed ages ($\hat{N}_{e(\text{mixed ages})}$) to that derived from an adjusted estimate of the number of breeders ($\hat{N}_{e(adj2)}$) varied widely across populations, ranging from $\hat{N}_{e(adj2)} \approx 5\hat{N}_{e(\text{mixed ages})}$ to $\hat{N}_{e(adj2)} \approx 0.7\,\hat{N}_{e(\text{mixed ages})}$, highlighting the importance of precision and bias correction for the proper estimation of the N_e/N_c ratios in systems with overlapping generations and iteroparous reproduction.

2. Material and methods

(a) Study sites and sample collection

Brook trout (*S. fontinalis*) were collected from 12 coastal streams along the northwest shore of Nova Scotia in the summers of 2009–2015. DNA analysis was conducted on the samples collected between 2009 and 2013 ($n = 1870$; electronic supplementary material, table S1), whereas samples collected in 2014 and 2015 were used for the estimation of census population size through mark recapture ($n \approx 1300$ in each year), with subsets used for age ($n = 426$) and sexual maturity ($n = 66$) determination (see below). The 12 streams are located in independent watersheds that drain into the Bay of Fundy from near the top of the North Mountain (maximum relief 265 m; figure 1). Most streams have one or more waterfalls that are impassable for trout, some at the coast, resulting in completely landlocked populations, and others along the stream length, creating upstream landlocked populations and downstream populations that may receive immigrants from upstream (figure 1). Sampling was non-lethal. In 2009/2010 and 2012, brook trout were caught with baited minnow traps set for approximately 24 h at intervals along the streams. In 2013–2015, fish were collected by electrofishing. Fish were measured (fork length, FL) and fin clipped (adipose fin) before release. Fin clips were stored in 95% ethanol for subsequent DNA analysis.

(b) Population size ($\hat{N}_c$) estimation

Population (census) size N_c was estimated by mark–recapture using the Lincoln–Petersen method with each population sampled twice, two weeks apart in 2014, and either the same day or the next day in 2015. Fish sampled for the purposes of estimating $\hat{N}_c$ (2014 and 2015) were not used for the genetic analysis in this study. In early July 2014 (8–11 July), 81 fish were captured, measured, marked and released in each stream population. Capture began in the section where fish had been sampled for genetic analysis in previous years. Electrofishing proceeded until more than 80 fish had been captured, fin clipped and released. The length of the sampled section was determined from GPS coordinates. Two weeks later (22–25 July in 2014) or the same or next day (July 2015), the same section of each stream was re-sampled, and the number of recaptures determined. One section of streambed was electrofished in 2014, whereas in 2015, we electrofished and resampled either the entire stream (RCD) or between two and four sections of streambed separated from each other by at least 500–750 m (two sections: SBU; three sections: RCU, WW, SBD; four sections: CV). We used the recapture rate and the number of fish (1+ or older) caught in the sampled length of stream to estimate density of adult fish (no of fish per m stream length). Population census size was then estimated by extrapolating to the length of stream over which there are no physical barriers to fish movement, this is a conservative estimate of N_c. Stream segment lengths were determined using ARCGIS (1 : 50 000). Streams were walked to locate waterfalls or other significant barriers (e.g. impassable culverts).

(c) Life-history characteristics

The key life-history characteristics needed for Waples *et al.*'s [10] corrections are age at maturity and AL or number of reproductive cycles. We used samples captured in July 2014 as our baseline population. The young of the year (YOY) class was almost certainly

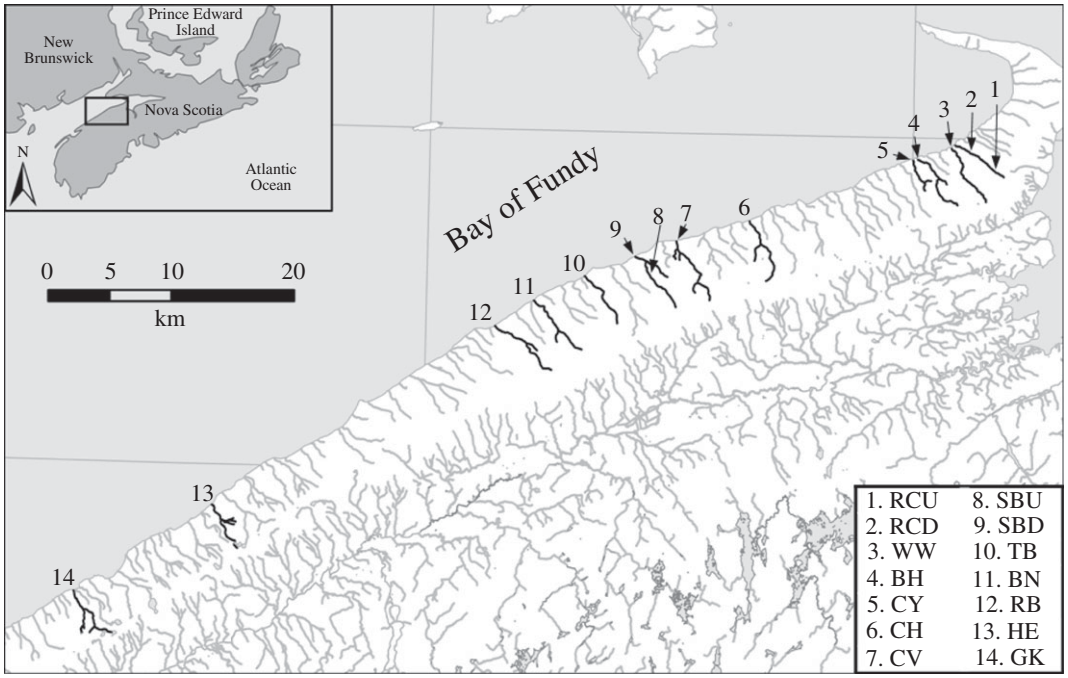

Figure 1. Streams sampled along the North Mountain in Nova Scotia. Streams run into the Bay of Fundy. The streams with their associated codes are from east to west: 1: Ross Creek upstream (RCU) and 2: Ross Creek downstream (RCD) of a major waterfall; 3: Woodworth (WW); 4: Black Hole (BH); 5: Cobby Irving (CY); 6: Chipman (CH); 7: Church Vault (CV); 8: Saunders Brook upstream (SBU) and 9: Saunders Brook downstream (SBD) of a major waterfall; 10: Turner (TB), 11: Brown (BN); 12: Robinson (RB); 13: Healy (HE); 14: Gaskill (GK). Inset shows study area in Nova Scotia. Populations at seven sites had intermittent access to the sea: RCD, WW, CH, SBD, RB, BN and GK. The remaining seven sites contained landlocked brook trout populations located upstream of major waterfalls (RCU, BH, CY, CV, SBU, HE) or a culvert impeding upstream brook trout passage (TB).

underrepresented in our sampling owing to their lower capture efficiency and possible differences in habitat use. Capture efficiency should have been similar for year classes older than YOY, and these individuals could thus be used for the determination of age structure as well as age at maturity.

A subsample of fish older than YOY ($n \approx 30$ per site for a total of 426 individuals) were weighed (live weight) and aged using scales to determine the relationship between size and age for these populations. The size range of each age class cohort and the weight–length relationship were determined. This information was then used to determine the age structure of the populations for the July 2013 sample (1151 fish in all). Annual mortality rate was also estimated for fish aged 1+ and 2+ years using $n = 1 -$ (number in $T + 1$ year class $\div$ number in T year class) [18].

Brook trout in Nova Scotia spawn from September to November, and alevin hatch the following spring. Fish ($n = 66$) from three sites (Ross Creek, Woodworth Creek and Cobby Irving Brook) were sacrificed to determine size (FL) and age at maturity. The abdominal cavity was opened to determine sex and maturity status (presence of ripe gonads). The female–male ratio for immature trout was assumed to be 1 : 1. This ratio was then used to approximate the proportion of mature females and mature males in each 1 cm length interval for the YOY, 1+ year and 2+ year age cohorts. Generation time, G, was then estimated by using a standard life table approach.

(d) Molecular protocol

Samples were digested overnight using proteinase K. DNA was extracted following a glassmilk protocol modified from Elphinstone *et al.* [19] using a Perkin Elmer Multiprobe II Plus Liquid Handling System (Perkin Elmer, Waltham, MA). Polymorphism was examined at 11 PCR amplified microsatellite loci (details in electronic supplementary material) labelled with either 700 or 800 nm M13 for downstream visualization. The resulting PCR products were imaged on Li-COR 4200/4300 DNA Analyzers (Li-Cor Biosciences, Lincoln, NE). Alleles were scored automatically using SAGA Automated Microsatellite Software 3.3 (Li-Cor Biosciences) and checked for repeatability of scoring (electronic supplementary material).

(e) Within-sample analysis

Microchecker (v. 2.2.3) [20] was used for detection of potential null alleles and large allele dropout. Expected and observed heterozygosities as well as deviations from Hardy–Weinberg equilibrium (HWE) and pairs of loci in LD were identified in Arlequin v. 3.5 [21]. The number of private alleles per stream was calculated using GenAlEx v. 6.4 [22]. Allelic richness was estimated using FSTAT v. 2.9.3.2 [23].

(f) Population structure

Pairwise F_{ST}s were estimated using GenAlEx v. 6.4 [22]. A principal coordinates analysis based on the matrix of pairwise F_{ST}s was conducted in R [24] using the package 'ape' [25]. Genetic structure was analysed using Structure v. 2.3.4 [26] with an admixture model and no location priors. Simulations were run for 1 000 000 iterations with an initial burnin of 500 000. Three replicates were run for each K-value from 1 to 15 using the entire dataset, and again for each subsequently identified cluster. The most probable K-values were chosen using the Evanno method [27] implemented in Structure Harvester v. 0.6.92 [28]. Once the most probable number of genetic clusters had been identified, seven more replications were produced, at that appropriate K-value, using structure resulting in 10 total replicates. These 10 replicates were combined using Clumpp v. 1.1.2 [29]. The resulting output from Clumpp was visualized using Distruct v. 1.1 [30]. Recent migration rates between the 14 sites were estimated using BayesAss v. 3.0.3 [31] with 30 million iterations (3 million burnin and parameters $a = 0.2$, $f = 0.2$ and $m = 0.05$).

(g) Effective population size and effective number of breeders

Estimates of effective population size ($\hat{N}_e$) were obtained with the LD method implemented in LDNe [32]. Estimates were obtained for each of the 31 location per year combinations (2009/2010: 12 streams; 2012: five locations from four streams; 2013: 14 locations from 12 streams). Second, we estimated effective population size using the temporal method as implemented in MLNE [33] with samples collected in 2009–2010 (2012 in one case) representing t_0 and those collected in 2013 representing t_1. Third, we also estimated effective number of breeders (N_b) using exclusively individuals of age class 1+. This was done only with the relatively large samples collected in 2013, for which sufficient individuals of age 1+ were available. Raw estimates of the effective number of breeders ($\hat{N}_b$) were adjusted using the method that involves two life-history traits, namely age at first reproduction (α) and adult lifespan (AL), as follows [10]:

$$\hat{N}_{b(adj2)} = \frac{\text{raw } \hat{N}b}{1.103 - 0.245\, x \log(\text{AL}/\propto)}. \quad (2.1)$$

Adjusted estimates of effective number of breeders ($\hat{N}_{b(adj2)}$) were then used to estimate $\hat{N}_{e(adj2)}$ as follows:

$$\hat{N}_{e(adj2)} = \frac{\hat{N}_{b(adj2)}}{0.485 + 0.758 \times \log(\text{AL}/\propto)}. \quad (2.2)$$

We thus obtained three estimates of effective population size per stream: two based on LD, one of which used mixed-ages data $\hat{N}_{e(LD,\,\text{mixed ages})}$, averaged over up to three estimates: mean ($\hat{N}_{e(LD,\,\text{mixed ages})}$) and the other single cohort data ($\hat{N}_{e(adj2)}$), and one based on drift between temporally spaced samples $\hat{N}_{e(MLNe)}$. These estimates were then compared with the estimates of census population size, ($\hat{N}_c$, individuals aged 1+ or older; see above). Lastly, we examined the role of variance in family size on these empirical $\hat{N}_e/(\hat{N}_c)$ by comparing them with ratios obtained with AgeNe [34] under varying degrees of variance in reproductive success.

3. Results

(a) Size at age

Cohorts were quite easily distinguishable. Mean lengths at age, averaged across sites, were 5.8, 11.4, 15.0 and 18.3 cm for YOY, 1+, 2+ and 3+, respectively (electronic supplementary material, table S2), using upper boundaries of 8 (YOY), 13–16 (1+) and 16–19 cm (2+). Annual mortality rates (estimated from age structure) were 0.43 and 0.64 for age classes 1+ and 2+, respectively (electronic supplementary material, table S2). The absence of individuals aged 4+ years suggests that fish rarely survive past their third year in these streams. Annual mortality for brook trout aged 3+ was therefore 1.0.

(b) Age at maturity (α) and adult lifespan

Length and age at maturity were estimated with data collected from three streams (RC, WW, CY) in the autumn (16 September) of 2014. Brook trout with FL less than 9.5 cm were immature and the proportion of mature trout increased with size from 0.09 at 10 cm FL to 1.0 at 13 cm FL, with an average across electrofished sites of 59% of trout aged 1+ being mature (electronic supplementary material, table S3*a*,*b*). The proportion of mature brook trout was similar for males and females. For females, the proportion of mature individuals was 0.0, 0.62 and 1.0 for YOY, 1+ and 2+, respectively. For males, the proportion of mature individuals was 0.0, 0.44 and 1.0 zero for YOY, age 1+ and age 2+, respectively (electronic supplementary material, table S3*c*). Only two individuals aged 3+ were sampled and were not included in the evaluation. Overall, therefore, weighted age at maturity was $\alpha = 2.41$. Given that oldest age at reproduction is 3, adult lifespan is AL = 3 + 1 − 2.41 = 1.59. All subsequent estimates of $\hat{N}_{b(adj2)}$ and $\hat{N}_{e(adj2)}$ were thus obtained using $\alpha = 2.41$ and AL = 1.59. Generation length, estimated using the proportion of eggs contributed to the next generation by females aged 1+, 2+ and 3+, was $G = 1.88$ years (electronic supplementary material, table S4).

(c) Census population sizes

Census population size estimates, $\hat{N}_c$, ranged from as low as 854 individuals for BH to 12 000 individuals for CV in 2014, with an average (median) estimate across populations of between 3600 and 4000 (2100–2500), depending on whether a mixture of 2014 and 2015 or only 2014 estimates were used (electronic supplementary material, table S5).

(d) Within-sample analysis

Average (median) scoring repeatability across 11 microsatellite loci was 98.5% (98.8%) (electronic supplementary material, table S6). Observed and expected heterozygosities ranged from 0.360 and 0.366 to 0.577 and 0.628, respectively (electronic supplementary material, table S7). Loci were moderately polymorphic with allelic richness, ranging from 3.37 to 6.60 (electronic supplementary material, table S7). The number of private alleles per population ranged from 0 to 4. The number and identity of loci presenting potential null alleles varied across samples and included 0 or 1 locus with potential null alleles (5 and 17 samples, respectively), 2, 3 and 4 loci with potential null alleles (five, two and two samples, respectively; electronic supplementary material, table S7). Similarly, the number (and identity) of loci out of HWE varied across samples, with eight samples exhibiting no locus out of HWE and one sample exhibiting four loci out of HWE, with other samples exhibiting an intermediate number. The lack of consistency among populations in the identity of the loci exhibiting departures from HWE suggest these departures are not owing to null alleles. Rather, they probably result from the interaction of small effective sizes with age structure (i.e. cohorts differing in allele frequencies leading to an intercohort Wahlund effect) along with the potential existence of siblings and spatial or deme structure within streams. Similarly, although eight populations exhibited at least one pair of loci in gametic phase disequilibrium (electronic supplementary material, table S7), the pair identity varied across populations, suggesting their detection results from random sampling effects rather than actual physical linkage between loci. F_{IS} overall loci ranged from 0.023 (RB) to 0.162 (HE) (median across populations, $F_{IS} = 0.066$), indicating close similarity between observed and expected heterozygosities within populations (electronic supplementary material, table S8).

(e) Population structure and gene flow

A hierarchical structure analysis revealed the existence of population structure at the level of individual streams (electronic supplementary material, figure S1). A plot of the first two coordinates of a principal coordinate analysis (PCA)

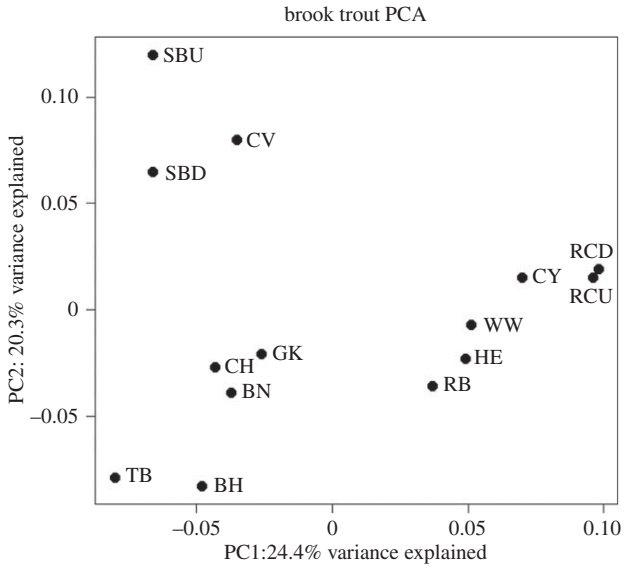

Figure 2. Principal coordinate analysis (PCA) based on 11 loci for brook trout collected from 12 streams (14 sites).

based on the matrix of pairwise F_{ST}s (figure 2; electronic supplementary material, table S9) provided results consistent with those obtained with STRUCTURE: RCU and RCD appear genetically similar to each other, and to a lesser degree also to the neighbouring WW and CY and to the more distant HE and RB, while they appear more different from the remaining populations. Similarly, SBU and SBD appear more similar to each other and to the neighbouring CV than to the remaining populations, with the remaining populations exhibiting varying degrees of differentiation (figure 2). Migration rates estimated with BAYESASS were low to nil (not shown), indicating little to no gene flow between populations, with one exception: RCU and RCD exhibited a sufficiently low $\hat{F}_{ST}$ (0.008) to prevent the reliable estimation of m.

(f) Effective population size ($\hat{N}_e$), effective number of breeders ($\hat{N}_b$) and census population size ($\hat{N}_c$), and their ratios using raw and adjusted estimates

Effective population sizes were estimated for each of the 31 stream/sampling year combinations (2009/2010, 2012, 2013) using the LD method and all sampled individuals regardless of age ($\hat{N}_{e(LD,\ mixed\ ages)}$; electronic supplementary material, table S10). For each stream, we then calculated the weighted harmonic mean across years (mean$\hat{N}_{e(LD,\ mixed\ ages)}$) using sample sizes as weights (electronic supplementary material, table S10; table 1). Effective sizes were also estimated using the temporal method ($\hat{N}_{e(MLNe)}$; electronic supplementary material, table S10; table 1). Lastly, we also estimated the raw effective number of breeders ($\hat{N}_b$) (electronic supplementary material, table S11) from which we calculated $\hat{N}_{b(adj2)}$ (electronic supplementary material, table S11) and $\hat{N}_{e(adj2)}$ following equations (2.1) and (2.2), and assuming AL = 1.59 and $\alpha = 2.41$ (electronic supplementary material, table S11). We thus obtained three estimates of effective size for each population (table 1). Across all populations, mean ($\hat{N}_{e(LD,\ mixed\ ages)}$) ≈ 206 (median ≈ 142). Among the six populations for which we obtained all three estimates, the means (medians) were $\hat{N}_{e(LD,\ mixed\ ages)} \approx 113$ (126), $\hat{N}_{e(MLNe)} \approx 40$ (44) and $\hat{N}_{e(adj2)} \approx 227$ (125). Individually, $\hat{N}_{e(adj2)} > \hat{N}_{e(LD,\ mixed\ ages)}$ in five of the six cases with median ratio $[\hat{N}_{e(adj2)}/\hat{N}_{e(LD,\ mixed\ ages)}] \approx 1.66$ while median ratio $[\hat{N}_{e(adj2)}/\hat{N}_{e(MLNe)}] \approx 4.7$ and median ratio $[\text{mean}(\hat{N}_{e(LD,\ mixed\ ages)})/\hat{N}_{e(MLNe)}] \approx 2.88$ (range 1.8–4.6). Individually though, $\hat{N}_{e(adj2)}$ could be up to nearly five times larger than estimates obtained from mixed ages (CY) and 13 times larger than estimates obtained with the temporal method (CY, WW; table 1). Similarly, estimates obtained with the LD method using individuals of mixed ages could be up to nearly five times larger than estimates obtained with the temporal method.

Each of these estimates was then related to census population size $\hat{N}_c$. The ratio of the mean$(\hat{N}_{e(LD,\ mixed\ ages)})/\hat{N}_c < 0.10$ in all but three cases, with the lowest ratio being approximately 0.01 (CV) and the largest being approximately 0.18 (median = 0.078 [0.046] for the six populations with available $\hat{N}_{e(adj2)}$; table 1). Such wide range in the ratio of effective to census size is also observed among the $[\hat{N}_{e(adj2)}/\hat{N}_c]$ ratios (table 1), where they lie in the 20–30% range in two populations (WW, CY), in the 10% in one (GK), 5% in two (RCU, HE) and 1% in the remaining two (CV, TB) of the seven populations for which $\hat{N}_{e(adj2)}$could be estimated (median = 0.048; table 1). Such vast differences in effective to census size, regardless of how effective size is measured implicate vast differences in reproductive dynamics among these brook trout populations.

Predictably, the median $(\hat{N}_{e(MLNe)}/\hat{N}_c)$ was lower than with the other methods (0.011), but still, important differences were observed among populations (table 1) with one population exhibiting a ratio = 0.133, five exhibiting ratios in the 0.02–0.05 range, and seven exhibiting ratios less than or equal to 0.01 (table 1), once again implicating difference in reproductive dynamics among populations.

Next, we examined the range of reproductive skew required to attain these ratios using AGENE based on each population's age-specific survival rates (electronic supplementary material, table S2) and relative fecundity [35]. We assumed relative fecundities for 2+ and 3+ males were, respectively, three and four times that of a 1+ male, a reasonable assumption given that a 3+-year-old is approximately twice as along as a 1+-year-old. This resulted in a generation length for males similar to that for females. Using the above values for these life-history traits, the Poisson factor (variance in reproductive success over its mean, $V_k/\bar{k}$) ranged from a low of between 5 and 10 for four populations (RCD, WW, BH, CY) to a high of 120 and 200 for two populations (TB and CV, respectively) and was intermediate (20–50) in the other four (RCU, CH, SBD, HE; table 1). In general, and using estimates of age-specific survival rates averaged over all populations, observing a ratio $\hat{N}_e/\hat{N}_c \approx 0.180$ requires a skew in reproductive success (Poisson factor) ≈ 10, a ratio $\hat{N}_e/\hat{N}_c$ in the range of 0.040–0.020 requires a skew in the range of 50–100, and a ratio $\hat{N}_e/\hat{N}_c \approx 0.010$ requires a skew ≈200.

4. Discussion

Waples *et al.* [10] recently presented the methods for adjusting estimates of effective population size (N_e) and effective number of breeders (N_b) in iteroparous populations by accounting for the impact of AL and age at first maturation. We have shown the importance of those adjustments for small brook trout populations; adjusted estimates of N_e derived from adjusted

Table 1. Mean ($\hat{N}_{e(\text{mixed ages})}$) and $\hat{N}_{e(\text{MLNe})}$: effective population size estimates obtained, respectively, from linkage disequilibrium in a random sample of individuals of mixed ages, and from genetic drift between temporal samples (both from electronic supplementary material, table S11). $\hat{N}_{e(\text{adj2})}$: effective population size, adjusted on the basis of two life-history traits, adult lifespan (AL = 1.59) and age at maturation ($\alpha = 2.41$) (from electronic supplementary material, table S11). Ratios of $\hat{N}_{e(\text{adj2})}$/Mean ($\hat{N}_{e(\text{LD, mixed ages})}$), and $\hat{N}_{e(\text{adj2})}/\hat{N}_{e(\text{MLNe})}$. $\hat{N}_c$: census population size over stem length over which there is no barrier to fish movement (from electronic supplementary material, table S5). *Mean* ($\hat{N}_{e(\text{mixed ages})}$)$/\hat{N}_c$, $\hat{N}_{e(\text{MLNe})}/\hat{N}_c$ and $\hat{N}_{e(\text{adj2})}/\hat{N}_c$: ratios of population effective to census size, where effective sizes were derived, respectively, from mixed ages, from the temporal method, and $\hat{N}_{e(\text{adj2})}$. Variance in reproductive success over its mean or Poisson factor (V_k/k) as entered in AgeNe to obtain the observed $\hat{N}_{e(\text{adj2})}/\hat{N}_c$ (when available) or the observed *mean* ($\hat{N}_{e(\text{mixed ages})}$)$/\hat{N}_c$ given each population age-specific survival rates as shown in electronic supplementary material, table S2.

stream	mean ($\hat{N}_{e\ (\text{LD, mixed ages})}$)	$\hat{N}_{e(\text{MLNe})}$ (95% CI)	$\hat{N}_{e(\text{adj2})}$ (95% CI)	$\hat{N}_{e(\text{adj2})}$ /mean ($\hat{N}_{e\ (\text{LD, mixed ages})}$)	$\hat{N}_{e(\text{adj2})}/\hat{N}_{e(\text{MLNe})}$	$\hat{N}_c$	mean ($\hat{N}_{e(\text{LD, mixed ages})}$)$/\hat{N}_c$	$\hat{N}_{e(\text{MLNe})}/\hat{N}_c$	$\hat{N}_{e(\text{adj2})}/\hat{N}_c$	Poisson factor (V_k^-/k^-)
RCU	127.3 (41 – ∞)	40.8 (28 – 68)	189 (55 – ∞)	1.48	4.63	3953 – 4680	0.032 – 0.027	0.009 – 0.010	0.040 – 0.048	50
RCD	235.0 (72 – ∞)	32.8 (25 – 44)	— (158 – ∞)	—	—	1369 – 690	0.172 – 0.341	0.024 – 0.048		5 – 10
WW	124.6 (58 – ∞)	27.2 (21 – 36)	363 (109 – ∞)	2.91	13.35	1370 – 1800	0.091 – 0.070	0.015 – 0.020	0.202 – 0.265	7.5
BH	151.3 (36 – ∞)	114.0 (62 – 341)	— (65 – ∞)	—	—	854	0.177	0.133	—	10
CY	135.4 (55 – ∞)	50.1 (35 – 79)	646 (52 – ∞)	4.77	12.89	2235	0.061	0.022	0.289	5
CH	446.5 (80 – ∞)	24.4 (18 – 34)	— (90 – ∞)	—	—	6139	0.073	0.004	—	30
CV	141.6 (40 – ∞)	46.4 (33 – 70)	98 (75 – ∞)	0.69	2.11	12166	0.012	0.004 – 0.006	0.008 – 0.013	200
SBU	595 (32 – ∞)	—	— (48 – ∞)	—	—	5066 – 3850	0.117 – 0.155	—	—	10 – 15
SBD	155.5 (63 – ∞)	72.4 (47 – 133)	— (356 – ∞)	—	—	2780 – 2000	0.056 – 0.078	0.026 – 0.036	—	30
TB	— (108 – ∞)	47.4 (31 – 81)	74 (23 – ∞)	—	1.56	5296	—	0.009	0.014	120
BN	— (168 – ∞)	15.0 (12 – 17)	— (195 – ∞)	—	—	1417	—	0.011	—	
RB	— (123 – ∞)	37.3 (25 – 63)	—	—	—	10833	—	0.003	—	
HE	48.6 (27 – ∞)	18.8 (15 – 25)	89 (49 – 701)	1.83	4.73	1878	0.026	0.010	0.047	50
GK	102.5 (49 – ∞)	57.4 (36 – 111)	125 (75 – 949)	1.22	2.18	1299	0.079	0.044	0.096	20

estimates of N_b ranged from nearly fivefold larger than to around 30% smaller than unadjusted estimates of N_e derived from random samples of individuals of mixed ages. These results suggest that published estimates of effective population size obtained with random samples of individuals of mixed ages for iteroparous species with overlapping generations and even those based on unadjusted $\hat{N}_b$ can be biased, and should thus be considered with caution. As seen in other studies [15–17], we also found that $\hat{N}_{e(adj2)}/\hat{N}_c$ ratios were variable across populations in the same geographical area, ranging from a high of 0.29 (CY) to a low of around 0.01 (e.g. CV, TB). These differences presumably reflect differences in population dynamics potentially mediated through differences among streams in environmental characteristics and productivity, which will probably affect the intensity of competition for access to mates, or for redd sites. In fact, we found that, given the observed age-specific survival rates and the known age-specific relative fecundities, very high variances in reproductive success in the order of $V_k/k \approx 50–200$ are needed to exhibit $\hat{N}_e/\hat{N}_c$ ratios in the range of 0.05–0.01. Irrespective of the differences, the majority of the $\hat{N}_{e(adj2)}/\hat{N}_c$ ratios were very low, the median ratio was 0.048, considerably smaller than the 0.20 median ratio described by Palstra & Ruzzante [4] for small salmonid populations. In this study, this ratio was between 20% and 30% in two populations (WW, CY) and was otherwise less than or equal to 0.1 (table 1).

Before discussing the results in detail, we raise four caveats. First, we have used estimates of age at first maturation (α), AL and generation length (G) that were averages across populations. It is possible, indeed likely, that these parameters varied somewhat across populations, but much more intensive sampling would be required to accurately measure this variation. Second, our three $\hat{N}_e$ estimates refer to slightly different though overlapping time periods. Mean $\hat{N}_{e\ (LD,\ mixed\ ages)}$ represents averages (harmonic means) over the period 2009–2013, $\hat{N}_{e(MLNe)}$ is a temporal estimate over the same period, and $\hat{N}_{e(adj2)}$ is derived from an annual effective size estimate ($\hat{N}_b$) based on samples of 1+ year old individuals collected in 2013. The $\hat{N}_c$ estimates were instead obtained in 2014 with some estimates repeated in 2015. Thus, our $\hat{N}_e$ and $\hat{N}_c$ estimates do not refer to the same time period and this may have introduced an unknown bias in our ratio estimates (5) if population size varies dramatically between years. In our analysis, we have thus assumed population size remained constant between years. Third, 23 of the 31 samples exhibited between one and four loci out of HWE even after correction for multiple tests. These departures probably reflect real biological phenomena including the combined effect of small effective sizes and age structure, where cohorts differ in their allele frequencies resulting in an intercohort Wahlund effect, along with the potential existence of siblings and spatial or deme structure within streams. The extent to which these departures from HWE affect downstream analyses has unfortunately not been examined in detail [36]. Fourth, the N_e temporal estimates were generally smaller than those based on LD. This is not surprising given that the temporal method is expected to provide downwardly biased estimates when generations are not discrete and fewer than three to five generations have elapsed between samples. Regardless of this downward bias, the $(\hat{N}_{e(MLNe)}/\hat{N}_c)$ ratios differed among populations, and we inferred this is due to differences in reproductive dynamics among populations. In doing so, we assumed the potential bias introduced by age structure does not differ among populations.

(a) Effective number of breeders to effective population size $((\hat{N}_{b(adj2)}/\hat{N}_{e(LD,\ mixed\ ages)})$ ratios

We examined the relation between the annual effective size (N_b) and the generational effective population size ($\hat{N}_e$). This relationship had until recently been examined in detail largely only for semelparous age-structured species [37,38] (but see [8,39]). Following these studies, it was assumed that in iteroparous species, effective sizes were $\hat{N}_e \leq \hat{N}_b * G$, where G is generation length, which in turn implies that $\hat{N}_b \leq \hat{N}_e$ [10,40]. It has since been shown that this is not necessarily true and that in iteroparous species $\hat{N}_b$ can indeed be $>\hat{N}_e$, with evidence the $\hat{N}_b/\hat{N}_e$ ratio reported to vary across species by a factor of 6 from 0.3 to 1.6 [10]. In fact, here we show a similar range of variation in this ratio among the six populations for which we were able to estimate both $\hat{N}_{b(adj2)}$ and $\hat{N}_{e(LD,\ mixed\ ages)}$; $\hat{N}_{b(adj2)}/\hat{N}_{e(LD,\ mixed\ ages)} = 1.66$ in one population (CY), $\hat{N}_{b(adj2)}/\hat{N}_{e(LD,\ mixed\ ages)} \approx 1$ in another (WW) and $\hat{N}_{b(adj2)}/\hat{N}_{e(LD,\ mixed\ ages)}$ between 0.63 and 0.24 in the remaining four populations. These wide interpopulation differences in $\hat{N}_b/\hat{N}_e$ ratios suggest, again, the existence of important differences in population dynamics across streams within a single reproductive season (see above). An issue currently under investigation in our laboratory concerns the degree to which within-population temporal changes in $\hat{N}_b$ match the among-population differences in $\hat{N}_b$ and how they relate to variation in $\hat{N}_c$ (see below and [37,38]). It should be noted though, that estimates of $N_{e(LD,\ mixed\ ages)}$ have been shown to provide estimates of N_e that are up to 93% of the true N_e in species with life histories similar to those of our brook trout populations [10]. In other words, N_e is supposed to be slightly underestimated when using a random sample of individuals of mixed ages. In fact, the majority (five out of six) of our $\hat{N}_{e(LD,\ mixed\ ages)}$ are smaller than $\hat{N}_{e(adj2)}$. In the following section, we discuss our analyses of the ratios of effective to census population size based on both $\hat{N}_{e(LD,\ mixed\ ages)}$ and $\hat{N}_{e(adj2)}$ (table 1).

(b) Effective population size to census population size $(\hat{N}_e/\hat{N}_c)$ ratios

Census population size was estimated by extrapolating fish density over the electrofished streambed section (estimated through mark recapture), to the length of the stream over which there was no obvious barrier to fish movement. This scale is well within the range of adult brook trout movement [41,42]. Our results indicate that at this spatial scale, the $(\hat{N}_e/\hat{N}_c)$ ratios are both low relative to the ratios generally expected in small populations of salmonids ($\hat{N}_e/\hat{N}_c \sim 0.20$, [4]) and extremely variable across populations (table 1).

Palstra & Fraser [5] argued that uncertainty in the estimates of effective population size ($\hat{N}_e$) translates into uncertainty into the ratios $(\hat{N}_e/\hat{N}_c)$. Although we have considerably reduced the uncertainty in the individual $\hat{N}_e$ estimates, we still find major differences in the $\hat{N}_e/\hat{N}_c$ ratios across populations within a single species. These results suggest that uncertainty is not the only cause, perhaps not even the major cause for intraspecific variation in these ratios. The variation probably reflects a real biological

phenomenon and is a function of variation in the effective number of breeders (see also [14,39,43]) and in reproductive success. In fact, given the estimated age-specific survival rates and age- or size-specific relative frequencies, we have shown with AgeNe [34] that very high variances in reproductive success (between 50 and 100 times higher than the mean reproductive success) are necessary to generate $\hat{N}_e/\hat{N}_c$ in the 0.05–0.02 range (200 times higher to generate ratios ≈ 0.01).

Theory predicts that N_e/N_c ratios should be low in species with early maturity and long reproductive lifespan because of the large variance in reproductive success that can ensue from such combination of life-history traits [10]. Here we have shown that these ratios can also be low even when AL and age at maturity are relatively short. Our estimates reflect the N_e/N_c ratios across a number of brook trout populations at a particular point in time. We have not quantified how these ratios vary over time within populations and how they relate to variation in $\hat{N}_c$; this is the focus of our ongoing work. Long-lived sturgeon, for instance, have been described as having relatively stable interannual variation in $\hat{N}_b/\hat{N}_c$ ratios (0.27–0.86) despite a 40-fold difference in annual larval production [44]. This result was attributed to a low variance in reproductive success probably stemming from the polygamous mating system and the large number of adults breeding in a temporally stable population [44]. Similarly, recent studies on stream brook trout populations found that $\hat{N}_b$ was stable relative to $\hat{N}_c$ with no evidence of a relationship between these two metrics but a link between $\hat{N}_b$ and stream flow [39]. Understanding relationships between N_e, N_b and N_c and how these relate to population dynamics and fluctuations in population size are important for the design of robust strategies for species of conservation concern, and we encourage further efforts to improve our understanding of these relationships.

Ethics. The sampling was conducted under fishing permit no. 321158 issued to the Inland Fisheries Division of the Nova Scotia Department of Fisheries and Aquaculture.

Data accessibility. Genotypic data have been uploaded to Dryad and are available for download: http://dx.doi.org/10.5061/dryad.nh448.

Author contributions. D.E.R. and S.J.W. designed the study. K.H., S.P. and G.R.M. produced the molecular data and conducted initial analyses as part of two honours theses (K.H. 2010, S.P. 2014). A.C. and J.M. conducted the analysis on life-history traits. D.E.R. and G.R.M. conducted further analysis. D.E.R. wrote the first draft with input from S.J.W., G.R.M. and J.M. All authors contributed to fieldwork.

Competing interests. We declare we have no competing interests.

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Lands and Forestry

M E M O R A N D U M

TO: Renata Mageste da Silva, NS Department of Environment

FROM: Department of Lands and Forestry

DATE: April 8, 2020

RE: Spicer North Mountain Quarry

The Department of Lands and Forestry (Department) provides the following comments on the above project:

Crown Lands:

This project is not on Crown lands and would not require any approvals/authorities from Land Administration.

Wildlife, Wildlife Habitat and Surveys:

The Department has the following concerns:

- **Section 5.6.1 Avian SARA/SOCI.**
  - Information presented in this section refers to the Eastern Wood-pewee as being the only SAR on the quarry while Figure 39 shows this is not the case**. It is not possible to determine accuracy of the information presented in the EA since no GIS field data was provided.**
  - The access road and stockpile areas show the presence of SARA/SOCI such as Eastern Wood-pewee, however the focus of this section is on the quarry expansion area. All areas of this proposed project should be discussed including the access road and stockpile areas
- The document says that there is a "*…low to moderate probability Eastern Wood-pewee would actively be using habitat within the Study Area*". However, it also states that 9 Eastern Wood Pewee were found in the study area, 4 of which were found in the area being assessed as part of this EA. These two statements are contradictory.
  - Page 99 says: "*There is a moderate probability that suitable Common Nighthawk nesting and forage habitat exists in or near the Project Site. No Common Nighthawk were observed during 2019 field surveys of the Study Area. The ornithologist assessing the site predicts that the habitat within the proposed expansion area is not suitable for the species given the*

varied age and structure of the patchwork forested habitat there. However, the ornithologist did consider the presence of Common Nighthawk a reasonable possibility considering the amount of bare rock and gravel within the Study Area, and the clearcut on property east of the study area and proposed expansion area." **Given this statement, and proximity of Common Nighthawk to the area (according to Atlantic Canada Conservation Data Centre (ACCDC) records), a dedicated survey should have been conducted for the Common Nighthawk within the Study Area.**

- **Section 5.6.4. Lichen SAR/SOCI. ACCDC records show Wrinkled Shingle Lichen (*Pannaria lurida,* NSESA Threatened 2017, COSEWIC Threatened 2016, SARA Threatened 2019) as occurring within 2.5km of the Study Area. This information was not captured within the EA and does not appear in the ACCDC data submission records in Appendix 2.**

- **Section 5.6.5. Mammalian SAR/SOCI.**
  - There are contradictory statements in this section: first, that no bat species were found within 20km of the Study Area during the desktop survey; second, the 2010 echolocation survey located 7.5km away found the presence of bats in similar habitat to the one currently being evaluated through this EA.
  - **"***Given these declines, no surveys were conducted for bats during the EA process, and no bats were incidentally observed in the field.*" **Species declines should not be used as justification for not conducting surveys.**

- **Section 9.1.3 Terrestrial Environment. Mitigation measures are not provided in sufficient detail in Table 36.**
  - The EA, recommends that species that weren't native to the area and non-problematic weed species could be used in site reclamation. The Department would not recommend this approach.
  - No indication as to how the viability of native soils and seed bank will be maintained, and no monitoring of re-establishment.
  - Insufficient detail on noise and air quality levels that would support proponent's intention to minimize impact on terrestrial species.
  - Light pollution impacts on birds and other wildlife species are not provided.
  - The proponent did not provide a definition of "productive terrestrial wildlife habitat".

- **Section 9.1.5 Species at Risk and Species of Conservation Interest. Mitigation measures are lacking with respect to identified SAR species within the Study Area.** In addition, the statement "*A number of avian SAR and SOCI were observed during EA studies in and around operational activities that have occurred for 11 years, indicating limited adverse effects and or behavior modification to those effects by species present.*" is misleading, as there is no

baseline information available to support this narrative.

- **Section 9.2 Residual Environmental Effects**. Table 42 does not reflect that there is a likelihood of differing adversity categories for the same activity depending on whether it is biophysical or socio-economic.

- **9.3 Monitoring. The monitoring plan as presented does not provide sufficient detail and will need to be further developed as part of the Wildlife Management Plan.** Specifically, a three (3) year invasive plant species search program is not adequate given the amount of vehicle traffic within the Study Area.

- **Appendix 3. Avian Survey Report. It is unclear how certain surveys were conducted.** For example, how observations were detected and recorded as part of the breeding surveys. Further detail is required to assess the validity of survey efforts and survey results.

Recommendations:

The Department recommends that the following mitigation measures be considered as conditions of approval for the project to address the Department's concerns:

- **Data for all S1-S3 ranked species and any COSEWIC, SARA, or NSESA Species at Risk must be provided to the Wildlife Division, Department of Lands and Forestry.** Also include in the submission all plot locations, transects, and other field survey data.

- As a result of discrepancies in the data submission for section 5.6.1**, a Common Nighthawk survey is requested to be completed as a condition of approval for this EA. If it is not possible to conduct a Common Nighthawk survey, the proponent must provide mitigation measures under the Wildlife Management Plan with the assumption that this species already occurs within the Study Area.**

- Due to the discrepancies and issues surrounding justifications and data assessment within section 5.6.5, **a bat survey is requested as a condition for approval of this EA. Subject to completion of this survey, additional mitigation measures may be requested.**

- **A Wildlife Management Plan encompassing all aspects of proposed activities (including the quarry, roads, and stockpile areas) must be submitted to the Wildlife Division, Department of Lands and Forestry and approved prior to commencing work and must contain the following:**
    - o Measures to deter nuisance wildlife;
    - o Detailed measures to prevent the establishment and spread of invasive plant species and seeds;

- Mitigation of impacts of noise, light, and dust pollution on wildlife;
- A communication plan with the Wildlife Division, Regional Biologist, and other relevant Department of Lands and Forestry staff;
- Measures to ensure that the company is in compliance with all relevant provincial and federal Acts and Regulations pertaining to wildlife species and species at risk;
- Detailed measures to protect the following species at risk and their habitat needs: Canada Warbler, Eastern Wood-pewee, Common Nighthawk, American Eel;
- Measures to protect other species at risk which have the potential to be encountered in the area: Barn Swallow, Bank Swallow, and Bobolink (given the potential to artificially create habitat suitable for these species);
- Given topography, traffic, vicinity to road, and drainage basin locations, a plan for regular monitoring of Wetland 8 to ensure ecological integrity is maintained.

NOVA SCOTIA
Department of Municipal Affairs and Housing

Maritime Centre, Floor 14 North
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PO Box 216
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Date: April 8, 2020

To: NS Environment

From: Department of Municipal Affairs and Housing

Subject: SPICER NORTH MOUNTAIN QUARRY EXPANSION PROJECT

As requested, the Department of Municipal Affairs and Housing has reviewed the Environmental Assessment Registration Documents for the proposed Spicer North Mountain Quarry Expansion Project. From the perspective of our Departmental mandates, we have no comments to submit relative to this EA review.

Thank you for the opportunity to review the Registration Documents for the above-noted project.

c: Alan Howell, Senior Planner, DMAH

NOVA SCOTIA
Environment

Barrington Place
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Canada B3J 2P8

Date: April 5, 2020

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Environmental Health

Subject: Spicer North Mountain Quarry Expansion Project

Scope of review:

The focus of this Environmental Assessment review from the NSE Sustainability and Applied Science Division's Regional Environmental Health Consultant is potential impacts on human health. In general, the scope of this review includes the assessment of the potential for the proposed undertaking/project to adversely affect human health in all phases of the project. Any recommendations provided below are meant to supplement the actions that are outlined in the EA submission documents.

Documents reviewed:

The documents outlined below formed the basis for this EA review, and is referred to as the 'EA submission' through the rest of this memorandum:

- Environmental Assessment Registration Document – Spicer North Mountain Quarry Expansion Project. Including Appendices 1 – 13 . Report Prepared by East Coast Aquatics Inc. Registered on Mar 9, 2020, and accessed from https://novascotia.ca/nse/ea/Spicer-North-Mountain-Quarry-Expansion-Project/default.asp

Noise

Given the separation distances to multiple residential properties and the permanent relocation of crushing activities to the stockpile area, it is recommended that noise monitoring should be implemented at commencement of the project as a condition of approval of this submission.

This should include data for all activities such as crushing, vehicular activities, blasting, etc. These original monitoring results should be used to determine if levels are within acceptable ranges or if additional mitigation measure must be taken to protect human health. it is recommended that a condition of approval would require the development and implementation of a plan to monitor noise levels. This plan should include, but not

be limited to, sampling locations, parameters, monitoring methods, protocols and frequency.

- Health Canada's- *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* uses the change in percentage of highly annoyed (%HA) as an appropriate indicator of noise-induced human health effects from exposure to project operational noise and to long-term construction noise exposure. Health Canada prefers that the increase in %HA per representative receptor (i.e. a group of residences in similar geographic proximity to the noise source) be evaluated and not the average increase in %HA for all receptors—which could underestimate the project-related impact on community annoyance. Noise mitigation measures should be considered when a change in the calculated %HA at any given receptor location exceeds 6.5%. – Health Canada

  Determination of Percent Highly annoyed (%HA) *in Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise*. Any noise monitoring should require the appropriate %HA (project construction or project operation) be reported and mitigation required when %HA exceeds 6.5%. Additionally, Health Canada recommends that mitigation of project noise be applied if it exceeds a day-night sound level (Ldn) of 75 dBA, even if the change in %HA does not exceed 6.5%.

  Risk to human health is determined using criteria from trusted authorities in health risk assessment such as Health Canada. While reference to the Pit and Quarry Guidelines and Nova Scotia Guidelines for Environmental Noise Measurement and Assessment are important from a regulatory point of view regarding noise, they do not represent the most up to date or preferred methodology for assessing risk to human health. The purpose of the EA is to evaluate impact on valued components, as human health is a valued component the most up to date and relevant resources should be utilized by the proponent regarding risk assessment for it to be considered protective. Further to this point the proponent should use Appendix B: Noise Impacts in EA Checklist of *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* as a guide for what should be included in an EA submission in relation to noise.

NOVA SCOTIA

Environment

Barrington Place
1903 Barrington Street
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Halifax, Nova Scotia
Canada B3J 2P8

Date: April 7, 2020

To: Renata Mageste da Silva, Environmental Assessment Officer

From: Climate Change Unit

Subject: Spicer North Quarry Expansion Project

Climate Change Mitigation

The proponent provided no information on the potential for greenhouse gas emissions. There were no estimates for potential CO_2, N_2O and CH_4 emission from the operation of onsite trucking, mobile equipment and utility vehicles. It is however expected that the emissions associated with the construction and operation will be low and will be captured by the reports of fuel supplier emitters under the Nova Scotia Greenhouse Gas Quantification Reporting Verification regulations.

The proponent also did not propose any mitigative measures for greenhouse gas emissions. While greenhouse gas emissions are expected to be low the proponent should consider mitigation measures to reduce emissions associated with the project.

Climate Change Adaptation

The proponent examined the impacts of climate change on their project, both in the short term and long term and outlined some mitigation measures.

From: Zhao, Lanying X <Lanying.Zhao@novascotia.ca>
Sent: April 8, 2020 2:58 PM
To: d'Entremont, Adam N <Adam.dEntremont@novascotia.ca>
Subject: RE: Spicer Quarry EA

Hello Adam,

I have reviewed the EA report B Spicer proposed quarry operation.

Based on the EA report, in particular, page 52 of the report, four monitoring wells were drilled for the existing quarry operation. However, Well1 collapsed totally, Well3 was partially collapse, Well4 was destroyed. It was only mentioned that Well2 is fully functional and will be used for monitoring. Two new wells (Well#5 and Well#6) were proposed to be located to the north east and northwest of the proposed future quarry footprint.

Previously I reviewed the 2016 groundwater sampling results and noticed that some metal concentrations and nitrate concentration were higher in some wells. This increasing might be affected by the quarry operation.

It is not clear how many wells will be monitored for the existing and proposed quarry operations. It shall be clarified which wells will be replaced and used for future monitoring. It is also suggested that one additional new well (Well7) will be proposed to install south/southeast of the proposed future quarry footprint. The information on how deep these new wells will be installed shall be provided. Well logs including GPS coordinates shall be well maintained. Copies of the well logs shall be submitted to the Department.

It is also recommended the residential well drilled in 2009, based on the location and site conditions, be integrated to the monitoring program and sampled along with the monitoring wells.

The abandoned wells including collapsed or destroyed wells shall be appropriately decommissioned.

The above is for your reference. If you get a chance please call me for discussion.

Thank you!
Lanying

Date: April 8, 2020

To: Renata Mageste da Silva, Nova Scotia Environment

From: Nova Scotia Office of Aboriginal Affairs

Subject: Spicer North Mountain Quarry Expansion Project

The Nova Scotia Office of Aboriginal Affairs (OAA) has reviewed the Environmental Assessment Registration Document for the proposed Spicer North Mountain Quarry Expansion Project, submitted by B. Spicer Construction Ltd., dated March 9, 2020. The review considered whether the information provided will assist the Province in assessing the potential of the proposed project to adversely impact established and/or asserted Mi'kmaw Aboriginal and Treaty rights.

OAA has reviewed the Environmental Registration Document for the proposed Spicer North Mountain Quarry Expansion Project and has no comments at this time. OAA will however, continue to work with the EA Branch to address any comments submitted by the Mi'kmaq of Nova Scotia through the Environmental Assessment process.

NOVA SCOTIA
Environment

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Date: April 8, 2020

To: Renata Mageste da Silva
Environmental Assessment Officer

Cc: Manager, Water Resources Management Unit

From: Senior Hydrogeologist, Sustainability and Applied Science Division

Subject: Spicer North Mountain Quarry Expansion Project

Environmental Assessment (EA) reviews from the NSE Sustainability and Applied Science Division Senior Hydrogeologist focus primarily on groundwater resources. This includes the potential for the proposed undertaking/project to adversely affect groundwater resources, including general groundwater quality, quantity, municipal water supplies, local water supply wells and groundwater contributions to stream baseflow, groundwater recharge and wetlands. The review is conducted of materials provided by the proponent during the EA registration process. Any recommendations made are based on this review.

B. Spicer Construction Ltd. of Annapolis County Nova Scotia proposes to expand an existing <4 Ha aggregate quarry located at located at 7297 Highway 1, Upper Granville, Annapolis County, Nova Scotia

The project is situated on private lands, on the south-facing slope of the Annapolis Valley's North Mountain, across several privately held properties (PID 05166004, 05166020, 05166095, 5289459, 5289467, 5289483, 5289475, 05166012,) owned by B. Spicer Construction Ltd. The proposed quarry area will involve an additional 9.5 Ha (based on Table 2, p.1) on these properties

The annual basalt aggregate production rate, which supplies local infrastructure projects, is anticipated to remain unchanged at the current rate of 100,000 to 150,000 metric tonnes/year and associated activities are expected to remain consistent with the current quarry operations.

The existing activity currently includes an active quarry area, grubbing and overburden stockpiles, aggregate stockpiles and crushing area, scales and office. The proposed activity will include:

- cutting, grubbing and piling of vegetation and topsoil,
- drilling, blasting and excavation of basalt,

- preparation of aggregates through screening and crushing,
- stockpiling of the prepared aggregates,
- intermittent operation of a mobile asphalt plant,
- fuel storage (diesel)
- delivery of aggregates and asphalt by truck through the principal quarry access road to Highway 1, and
- reclamation of areas following aggregate removal (p. 9).

Comments

The Spicer North Mountain Quarry registration document states that the quarry will maintain current production levels at its present location for two to four additional years. The Quarry Expansion occurs in an area 200 m to the north of the current quarry and is projected to last for a period of up to 30 years, or 2050.

- The location of the undertaking is not within a municipal drinking water Source Water Protection zone, drinking water Watershed or Wellfield Protection Area (WHPA) or a regulated Protected Water Area. The nearest Protected Water Area is the Cornwallis Protected Water Area (Lake Cady) which is about 25 km southwest of the site. In addition, a Municipal Drinking Water Watershed (Lake Cady/Moose River) is also associated with the Cornwallis PWA in the same location. This is the source water for Cornwallis Park.

- The nearest Source Water Protection Area (Groundwater) is for the Town of Bridgetown well field about 7 km east of the site

- The nearest Public Registered Drinking Water Supply is about 7 km west of the project site at the Crown Cove Cottages Inc., Granville Centre.

- The Nova Scotia Environment Well Logs Database (WLB) (as accessed through the Natural Resources Nova Scotia Groundwater Atlas interactive map) locates 10 (ten) drilled water wells within about a 2 km radius of the central point of the elongated project area. A number of these are actually site monitoring wells, submitted as water wells records

  However, it has been noted previously that the Well Logs Database Records and any mapping based on these records need to be considered in terms of locational errors/accuracy of the original data. In addition, the Well Logs Database does not contain a complete listing of every water supply well in the province and some areas may contain water supply wells not reported. Field truthing and field surveys for actual water supply well locations would be needed for verification.

- In the Registration Document it is noted likely that 3 residences exist with wells within 1 km of the south side of the quarry property. In addition, the document states that 14 wells within 2 km radius were present in the database (p. 50). However, this does not seem to include a number of wells to the south on the other side of the Annapolis River.

- The registration document notes the following: “Blasting and subsequent excavation of aggregates at the existing quarry is anticipated to occur from the existing surface elevation to an elevation of approximately 180masl as currently occurs. Blasting and subsequent excavation of aggregates at the future quarry location is anticipated to occur from the existing surface elevation to an elevation of approximately 190masl. Both elevations are to be a minimum of 1m above the groundwater table.” (p. 13)

- Figure 15 on p. 46 indicates that the quarry expansion area essentially has no overburden soils and is identified simply as bedrock. This seems simplistic and more information is needed on the overburden soil depths in that area and the location of the shallow water table. No other parts of the document discuss overburden soil depths at the site, although Table 35 (p. 123) indicates surficial soils will be excavated, removed and stockpiled for reclamation. The presence of wetlands also indicates at least some shallow soil presence.

- The proponent notes some design that will contribute to maintaining groundwater recharge. They note the value of wetlands in recharging groundwater (p. 77) as well as designing for a “seep away structure” to induce quarry floor drainage infiltration into groundwater (p. 20).

- For reclamation the proponent states “that a portion of the existing quarry floor be reclamated to wetland habitat and shaping of that reclamation feature can not begin while the existing quarry remains active.” P. 20. Reclamation to wetland habitat will require a thorough understanding and practical application to ensure groundwater levels for the reclamation are properly established.

- The potential for Acid Rock Drainage (ARD) from the quarry was not evaluated by sampling. The proponent states “Given the potential for ARD at the quarry site, no testing of rock for its potential contribution to acid rock drainage was conducted as part of the EA.” (p. 47). This is based on the geological rock type (basalt) and the opinion of the testing centre. As the area in question is not mapped for ARD and has not sampled, it may be considered prudent to process at least one rock sample of the quarry rock to confirm absence of ARD.

- The registration document notes that a groundwater monitoring program is in place for the approved quarry currently and that additional monitoring wells would be installed for the quarry expansion. According to the document of 4 installed deep monitoring wells, only 1 (MW 02) remains operational at this time. In addition, there are 3 shallow wetland piezometers that have been installed. The proponent states that 2 additional monitoring wells are to be installed.

- Groundwater monitoring, purging and sampling methodologies as provided in Appendix 11 appear to require updating to industry standards with regards to use of sterilized/preserved sample bottles, documented purging calculations for representative sampling and appropriate sample collection techniques such as field filtering and preservation.

- Groundwater monitoring provides necessary information to predict and avoid excavation below the shallow water table, as well as to avoid other adverse effects to groundwater potentially caused by quarry operations. Such a monitoring program would need to be designed and installed by a professional hydrogeologist (P.Geo or P.Eng) licensed to practice in Nova Scotia.

- A baseline water survey for residential water supply wells within 1 km of the proposed Quarry Development area is recommended to provide useful pre-construction water well and water quality data for contingency purposes, prior to quarry expansion. The proponent proposes sampling two of their own on-site residential wells (p. 56) and this may be expanded to include the other wells within 1 km.

- Pre-blast surveys of all water well supplies within 800 metres of the blast site/quarry should be a requirement. Well locations, well construction conditions, water levels, yield and water quality tests (including bacteria, general chemistry and metals) should be included in the survey.

- Section 9 Table 35 includes groundwater as a Valued Environmental Component (VEC) and lists a number of mitigation measures to prevent adverse effects (p. 123-1234).

- The quarry expansion location was designed to avoid direct removal of wetlands (Figure 3, p. 8). However, quarrying activities may alter shallow groundwater conditions immediately adjacent to remaining wetlands and these changes could have a potential adverse effect to flows in these wetlands and watercourses. Monitoring to have adequate time to prevent such effects is advisable.

Recommendations

The following recommendations are suggested based on the proposed Spicer North Mountain Quarry Expansion groundwater effects environmental assessment review:

Planning/Design Issues of Significant Importance

None identified.

Operational Issues/Other Permitting Processes

1. It is recommended that an industry-standard permanent monitoring well network be established for the site as designed by a professional hydrogeologist (P.Geo or P.Eng) licensed to practice in Nova Scotia. This should be established on the site prior to further quarry development, if approved, to assess the water table location, vertical gradients, groundwater flow directions, baseline (and background) water quality and to monitor for downgradient water quality and quantity effects, including the effects of groundwater recharge and groundwater-surface water interactions on nearby watercourses and

wetlands.

Groundwater monitoring at the site needs to be redefined with the following considerations in mind:

- Most of the previous monitoring wells for the quarry have been damaged over time. Replacement monitoring wells need to be designed and installed by a professional hydrogeologist (P.Geo or P.Eng) licensed to practice in Nova Scotia.

- The previous data and site location provide indication for strong downward recharge groundwater (vertical) gradients. Industry standard multi-level monitoring wells with different depths of completion should be installed to understand and define vertical gradient conditions

- Currently, there is not enough evidence to assume perched water table conditions in the shallow zone, but rather the data indicates strong vertical downward gradients from a shallow water table to a deeper water table at depth. This is expected in areas of high terrain with steep gradients to lower terrains. Multi-level monitoring wells with appropriate screened intervals can be used to gather information about the potential for unsaturated zones (which would underly perched zones) and water table location at different completion zone elevations.

- All new monitoring wells should be installed to assess groundwater conditions primarily from the shallow zone through to the final anticipated depth of quarry.

- The installation of very deep monitoring wells (e.g. 50 m +) likely do not give an appropriate indication of water table conditions at higher elevations, due to vertical recharge gradients. At least some of the monitoring wells wells (or multi-level zones) need to be completed for assessment/monitoring of the shallow zone water table conditions (i.e less than 10 metres).

- Shallow wetland piezometers installed to monitor the water table within wetlands as implemented currently can benefit by correlation with permanent multi-level monitoring wells that also demonstrate shallow water table elevations on the site.

- Groundwater monitoring well purging and sampling protocols as provided in the document need to be reviewed and updated to use appropriate industry standard methodologies.

2. It is recommended that all groundwater monitoring program design, installation and assessment work be prepared by a professional hydrogeologist (P.Geo or P.Eng) and submitted to the Department for review prior to acceptance.

3. A baseline water survey of residential water supply wells within 1 km of the Quarry Expansion area is recommended prior to the quarry development.

4. Pre-blast surveys of all residential/other water well supplies within 800 metres of the blast site/quarry should be a requirement. Well locations, well construction conditions,

water levels, yield and water quality tests (including bacteria, general chemistry and metals) should be included in the survey.

5. Should excavation within 1 metre of the measured maximum annual water table level, or below, be desired the proponent will need to provide additional information on potential effects and mitigation assessment and obtain an approval amendment. This recommendation cannot be followed unless a better understanding of hydrogeology at the site is obtained.

6. It is recommended that standard precautionary statements be provided in any approval terms and conditions that state, to the effect, that “the Proponent should replace or repair any water supply well found to be adversely affected by their quarry operation to the satisfaction of the well owner”.

Other Observations

There are undetermined, potential effects of altering the shallow groundwater regime in the vicinity of wetlands/watercourses, both on-site and off-site. While the proponent is planning to avoid wetlands directly, planning for prevention and mitigation of potential adverse effects of reduced groundwater flows to wetlands and watercourses is further recommended.

NOVA SCOTIA

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MEMORANDUM

To: **Renata Mageste da Silva, EA Branch**

From: **Water Resources Engineer, Water Resource Management Unit, Sustainability and Applied Science Division**

CC: **Jennifer Rocard, Manager, Water Resource Management Unit**

Date: **April 8, 2020**

Subject: **Spicer Mountain Quarry EA Review Comments**

Scope of review:

The scope of this Environmental Assessment review from the NSE Sustainability and Applied Science Division Hydrologist is to assess the potential environmental impacts and proposed mitigations of the proposed undertaking on surface water quantity and management. While comments may also include considerations for impacts on general surface water quality, groundwater, freshwater fish habitat, and wetlands, appropriate technical specialists for these areas should be consulted for specific review and comment.

Documents reviewed:

The documents outlined below formed the basis for this EA review, and is referred to as the 'the submission' through the rest of this memorandum:

- Environmental Assessment Registration – Spicer North Mountain Quarry Expansion. Report Prepared by East Coast Aquatics Inc. Dated February, 2020, and accessed from https://novascotia.ca/nse/ea/Spicer-North-Mountain-Quarry-Expansion-Project/default.asp

Review re: Spicer Mountain Quarry Expansion EA document:

General:

Water quantity: Watercourses and Site Drainage

- It is reported that “It is anticipated that this berm will then facilitate management of water and sediments at the proposed quarry site for at least the first half of its anticipated lifespan, providing long term protection to the downslope Wetland 1 and associated ephemeral watercourse.” (pg 18). It is unclear how this is providing protection to Wetland 1, and instead this berm looks to potentially divert surface flows away from the wetland?
- It is reported that “…surface drainage from the working quarry floor will be collected on the western boundary and directed to a catch basin in the southwest corner where heavier particulate matter can settle. This direction of discharge also helps maintain the original sub-catchment watershed size.”
    - No drainage areas have been delineated or provided in the submission, and the information provided both in text and in Figure 4 lack clarity surrounding where drainage from this area will end up. The ‘ephemeral drainages’ that are key to understanding what is being proposed is only outlined on Figure 9, which does not have contours or other valuable information surrounding the proposed works.
- The document states that “It is further proposed that discharge from the catch basin then be directed into a ~70m long armoured “seep away” structure constructed along the contour immediately downslope of the catch basin. This structure will restore any ditch concentrated flow collected off the future quarry floor to a more natural diffuse surface sheet flow (as currently exists) through the adjacent forested.” (pg 20).
    - Supporting information for what is proposed is very high-level, and without some level of information related to what criteria will be used in to support design of this feature and other such considerations, it is difficult to evaluate its appropriateness or have confidence in the statement that “This structure will restore any ditch concentrated flow collected off the future quarry floor to a more natural diffuse surface sheet flow…” (pg. 20).
- It is stated that “there are three small headwater stream channels in the area around the existing and proposed quarry footprint, none of which flow through either the existing or proposed quarry footprints.” (pg 69).
- The submission outlines that 0.5 ha that currently drains to Foster brook would be redirected into the catchment above Wetland 1 (pg 70).
    - Without drainage areas delineated for the site and provided as part of the submission, it is difficult to evaluate and have confidence in the assessment that is provided.
- Brook trout and American eel were captured in Ray Brook (pg 86), and it is reported that there “…appears to be a valuable Brook trout rearing habitat within the Study Area” (pg 91).
- The description of the methodology used to assess potential impacts to surface water quantity provided in Section 5.5.1 highlights a very high-level assessment of changes, with gaps that make it difficult to have a clear picture of the potential adverse effects associated with the proposed.
    - Maps/figures that provide support to the comments provided re: drainage patterns outlined on page 69 are not clearly provided. Drainage areas have not been delineated for pre and post development conditions, and very limited quantitative assessment is provided in the submission.

    - No discussion or assessment is provided related to expected changes to surface water quantity associated with the land use change that is proposed by the development of the quarry – i.e., potential changes to infiltration/runoff and resulting effects on downstream watercourses.
- It is understood through reading the document that no water withdrawals are planned as part of the proposed works. It is stated in the document that "No washed materials are produced as part of the quarry operations and no washing is proposed as part of this Undertaking…" (pg 17), but also mentions that "water is pumped out of a supply pond adjacent to the crushing area to suppress dust during the crushing portion of production" (pg 18). Details surrounding the potential source of this water are not provided in the submission.

Water Quality

- It is stated that "Additional sediment and erosion control measures at the new quarry footprint location will be required in future years and will be determined based on conditions encountered during development" (pg 12).
    - This statement is not clear how the need for additional sediment and erosion control features will be evaluated, or clear on what actions will be taken
- It is proposed that "The sediment catch basin can be periodically maintained as necessary to ensure proper ongoing function and will be monitored once annually in the fall for maintenance requirements" (pg. 20)
    - No details related to design criteria, management and operations, or other considerations for the 'sediment catch basin' features are provided in the text, and as such it is difficult to evaluate the appropriateness of these features as a mitigation measure.
- In the context of evaluating current operations compliance with Total Suspended Solids (TSS) requirements, it is reported that "The maximum increase has been exceeded 3 times over the past 8 years…" (pg 71).
    - It is also noted in the submission that anthropogenic sediment was observed along Ray Brook on the Spicer property (pg 91).
- From a review of TSS results and the identification of anthropogenic sediment documented along Ray Brook on the Spicer boundary, there are currently concerns related to the effectiveness of the erosion and sediment controls both currently in place and proposed as part of the submission.
    - Considering the above, additional details associated with the design criteria and planned operation of the 'sediment catch basins' proposed in the submission, are required in order to have confidence in this being an effective mitigation prior to the commencement of the proposed works

<u>Conclusions & Recommendations:</u>

The information that has currently been provided has gaps that make it difficult to assess the adverse environmental effects resulting from the proposed works. Please see below for a summary of issues and recommendations:

Operational Issues/Other Permitting Processes

- A detailed site surface water management plan should be developed by a qualified professional engineer with the intent of minimizing impacts and alterations to nearby surface water resources. This plan should include considerations for diversions of upstream areas around quarry footprints and minimizing changes to contributing drainage areas for the surrounding surface water resources.
- Details related to final settling pond designs (e.g., 'sediment catch basins' outlined in the submission) by a qualified professional engineer is required as part of any industrial approval application for the works, including a plan to monitor compliance during the different operational phases of the year. Designs must at minimum include considerations for appropriate remove of TSS and minimizing impacts to flow in watercourses downstream.
- A detailed sediment and erosion control plan is to be developed by a qualified professional and is required to be submitted as part of any industrial approval application for NSE review and approval prior to construction activities, including clearing, grubbing, and stripping, take place.
- Details relating to final 'seep away' structure designs by a qualified professional engineer is required as part of any industrial approval application for the works. Designs must include at minimum considerations for mitigating potential erosion and scour related to more significant rainfall events
- It is recommended that the water use for the purpose of dust suppression be evaluated to understand whether any additional approvals are necessary to support this specific activity
- A detailed surface water monitoring program is required to support on-going evaluation of the mitigations in place for the proposed works from a surface water quality perspective and to validate conclusions provided in the submission surrounding insignificant impacts to water quantity in the surrounding watercourses. This plan is to be submitted to NSE for review and approval prior to construction activities, including clearing, grubbing, and stripping, take place.

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NOVA SCOTIA

Environment

Date: April 8, 2020

To: Manager, Water Management Unit

From: Senior Surface Water Quality Specialist, Water Management Unit

Subject: Spicer North Mountain Quarry Expansion Environmental Assessment – Review Comments & Recommendations

Scope of Review

As Senior Surface Water Quality Specialist with the Nova Scotia Environment (NSE) Sustainability and Applied Science Division, the following Spicer Quarry Expansion Project Environmental Assessment (EA) review focuses on the following subjects:

- Surface water quality & its management
- General surface and groundwater resources, and fish and fish habitat & their management

The following review considers whether the environmental concerns associated with the above subjects and the proposed mitigation measures have been adequately addressed in the Environmental Assessment. The recommendations provided below are meant to supplement the actions outlined in the EA submission documents.

While general comments on fish and fish habitat, wetlands, surface water quantity, and groundwater quality and quantity may be included below, applicable technical specialists should be consulted for specific review and comment.

Reviewed Documents

The following document was the basis for this EA review:

East Coast Aquatics. 2020. *Spicer North Mountain Quarry Expansion*. Environmental Assessment Registration for a Class 1 Undertaking, Pursuant to Part IV of the Environment Act. NS. Reg 52/2005. B. Spicer Construction Ltd.

Comments

General

- Aggregate washing is not planned to be part of the proposed activity (Section 2.3.6).
- Dust management is proposed to reduce dust emissions from the Project activities, including use of water spray on a rock crusher and application of magnesium chloride once annually. The EA Registration Document identifies that

water for the activity is sourced from an existing supply pond at the Site replenished using an artesian well (spring). No discussion is provided on expected application volume and frequency. The volume applied and frequency of application may trigger the requirement for a water withdrawal approval application.

Surface Water Resources

- The EA Registration Document and NS hydrology geographic information system (GIS) layer identify that the proposed Project is located in the headwaters of Ray Brook (top of North Mountain), a tributary of the Annapolis River (Figure 1). Three tributaries of Ray Brook received drainage from the proposed quarry site and the expanded crusher/stockpile area.
- The proposed quarry site boundary is designed to provide a minimum 30 m buffer from adjacent field delineated wetlands and watercourses without requiring alterations.
- Wetland areas were identified/confirmed via East Coast Aquatics site visits within the Project area, including wetlands connected to the headwaters of unnamed tributaries of Ray Brook (Wetlands 1, 2, 3 and 8).
- The drainage areas for the wetlands and/or watercourses that would potentially intersect the proposed quarry site (7.04 ha; Table 2) have not been consistently delineated in the EA Registration Document (Section 5.5.1). A high-level assessment of the existing topography presented in Figure 4, indicates that the proposed quarry site area for existing conditions drains into Wetlands 1, 2 and 3, which drain into unnamed tributaries of Ray Brook, and Wetland 7. An 0.5 ha area is estimated to drain into Wetland 3 for the existing condition (Section 5.5.1).
- The expanded crushing site (additional 2.5 ha for total of 7 ha; Table 2) drains into a tributary of Ray Brook downstream of the proposed and existing quarry sites and Wetland 2.
- No municipal or private registered water supplies are located adjacent to or downstream of the Project area.

Surface Water Quality

- Baseline surface water quality monitoring was conducted at three sites (Wetland 3 outflow; Wetland 1 outflow; Ray Brook 15 m downstream of off-highway vehicle quarry access road) (Section 5.5.1 Surface Water Quality) on May 8 and October 24, 2019 with monitoring of parameters in the field using a multi-parameter probe and laboratory analysis of collected water samples for general chemistry and total metals by AGAT laboratories.
    - Comparison of the results with Canadian Council of Ministers of the Environment (CCME) protection of freshwater aquatic life criteria identified consistent criteria exceedances for total aluminum at all sites, low pH at the wetland outflow sites and one total iron exceedance at the Ray Brook site. Discussion is provided on the observed baseline exceedances, identifying potential sources, literature review evaluation to regional water quality studies and discussion of potential effects on aquatic life. The assessment approach for these limited samples is reasonable.
    - A summer event was not included in the program as it was expected the wetland outflow sites would not have observable flows.

- In support of maintaining compliance with the existing Industrial Approval (2007-056846-02), the Proponent has collected samples from two sites on Ray Brook (background/reference site – 75 m upstream of off-highway vehicle quarry access road; 15 m downstream of off-highway vehicle quarry access road) for one event annually during the spring freshet from 2011 to 2019. The program monitored a number of field parameters using a multi-parameter probe and collected water samples for total suspended solids (TSS) laboratory analysis at Envirosphere Consulting. In comparison to the TSS compliance criteria in the Industrial Approval, exceedances were identified for three sample events (3 of 9 events; 1/3 exceedance rate), including the 2019 monitoring event. The 2019 monitoring event exceedance was reported to Nova Scotia Environment staff. No details are provided on whether additional mitigation measures were implemented to address these quantifiable sediment loading events and prevent future events from occurring for the 2019 event and previous observed exceedances.
- Section 5.5.3 indicates the presence of a significant sand load within Ray Brook (segment downstream of Wetland 2, the existing quarry site and other operations). This discussion indicates that part of that sediment load is anthropogenically sourced and overall is higher than other assessed watercourses for the EA baseline study. This discussion is not presented in the Surface Water Quality section (Section 5.5.1), which would be more appropriate. The section recommends that maintenance of existing erosion and sediment control measures should be undertaken, and indicates monitoring is proposed to evaluate effects of sedimentation. Within an EA, it would be expected that those impacts from existing site activities, which are proposed to be expanded, would be evaluated as to their existing and potential effects on surface water resources and aquatic life, including fish and fish habitat. There is not enough information presented as to whether existing activities have negatively affected aquatic life in Ray Brook.
- Based on site geology and consultation with the Dalhousie University Minerals Engineering Centre, no quarry rock samples were collected and submitted for acid rock generation testing (Section 5.3.2). This approach is reasonable given the local geology of the Project area.
- Eight sediment basins (Figure 3; Section 2.3.6) with connecting drainage ditch ditches are identified as the drainage management system for the existing quarry site operations based on existing site drainage plan produced in 2008. Periodic hydroseeding of exposed mineral surfaces has been conducted at the site. A statement is provided that these activities are adequate based on the historic annual surface water quality monitoring results. Given that once per year surface water quality monitoring has been conducted from 2011 to 2019 with 3 of 9 events (1/3) exceeding the Industrial Approval discharge criteria, and the observed siltation within Ray Brook associated with anthropogenic inputs from existing site activities, the adequacy statement is not sufficiently supported.
- For the proposed quarry site, a new sediment basin is proposed to be constructed in the southwest corner to receive drainage from the full quarry area. The quarry floor will be sloped to drain to a constructed drainage along the west side that empties into the basin. Discharge from the basin is planned to enter a constructed 70 m long seep away structure. No details are provided on the criteria used for sizing the sediment basin and seep away structure, including design storm events and/or discharge water quality.
- Surface water quality monitoring is not explicitly proposed for the Project area for

the operations phase (Sections 2.3.6; 9.3). The program proposed is to monitor each sediment basin once annually in the fall prior to the start of wetter climatic conditions, and that existing structures will be maintained. There is no indication that surface water quality sampling will be included in this program or if it is assumed to be part of adhering to existing and future terms and conditions of the Industrial Approval.

- The adequacy of monitoring in the fall prior to wetter climatic conditions is reasonable for assessing whether maintenance is required to the site drainage infrastructure.
- If the fall monitoring event is proposed to be when surface water quality monitoring would occur, it would not adequately assess whether the infrastructure is adequately reducing sediment and associated metals loading to Ray Brook. A robust monitoring program would have monitoring events occur when outflows occur from drainage infrastructure to assess its efficacy in protecting surface water resources from sediment loading.
- No details are provided on potential monitoring site locations, sampling frequency or parameters for the Project. Parameters would typically include for quarry operations pH, TSS and select metals.

Fish and Fish Habitat

- The fish and fish habitat assessment did not identify suitable fish habitat in the Ray Brook tributaries immediately downstream of Wetlands 1 and 3. The Ray Brook tributary downstream of Wetland 2 was identified as supporting salmonid species and American eel.

Surface Water Quantity

- No discussion is provided on changes to surface water runoff from the existing forest land use to an active quarry for the Project area, or what is observed at the existing quarry site with respect to runoff differences from the surrounding landscape.
- Section 5.5.1 indicates that observed hardness in the Ray Brook tributary downstream of Wetland 2 at two monitoring sites, indicates potential groundwater contributions to flow from the Blomidon geologic formation. Section 5.3.3 indicates that groundwater contributes approximately 50% to watercourse flows near the toe of North Mountain, based on literature review, where the Project area is located.
- Reviewing existing topography and the development conceptual design for the full quarry site (Figure 4) without delineated drainage areas indicates the expected drainage changes to be the following, based on existing topography, conceptual drainage plans and a statement on drainage area changes in Section 5.5.1 about Wetland 3 only:
  - An increase in surface water runoff to Wetland 2 and the unnamed tributary of Ray Brook it empties into (Addition of drainage from full quarry site via sediment basin and outflow to seep away structure)
    - Or alternatively, a reduction if seep away lateral flows are diverted into the existing active quarry site
  - A decrease in surface water runoff to Wetland 1 and the unnamed tributary of Ray Brook it empties into (Removal of B2, B1, C2, C1 and D1 areas and directed to sediment basin and seep away; Addition of overburden

storage pile acting as potential berm to divert surface water runoff away from feature).
        - The proposed seep away structure as displayed in Figure 4 looks to direct drainage and infiltration towards the existing active quarry and to some level Wetland 2 and its downstream Ray Brook tributary catchment.
        - Section 5.3.3 indicates that with the berm and seep away that flows will be maintained to Wetland 1. As indicated in Figure 4, how this is feasible is not clearly presented given the above flow patterns proposed for the berm area and seep away.
    - A decrease in surface water runoff to Wetland 3 and the unnamed tributary it empties into (Removal of A3, B2, C2 areas, which is estimated to be 0.5 ha [Section 5.5.1]). There is an unknown potential for lateral subsurface flows from Wetland 3 to flow into the proposed quarry.
    - A decrease in surface water runoff to Wetland 7 (Removal of D1 area)

  The potential changes in flows in the tributaries of Ray Brook downstream of Wetlands 1 (decrease) and 2 (increase) are not quantified or assessed within the EA Registration Document with respect to their significance or how potential changes will be mitigated. The change to Wetland 3 hydrology is expected to not be measurable due to quarry activities.
- Shallow groundwater monitoring wells have been established in Wetlands 1 and 3, which are in the headwaters of two unnamed tributaries of Ray Brook with manual and automated water level monitoring proposed to occur prior to construction and during the operations phase of the proposed quarry site (Section 5.5.2). Monitoring of water levels and associated changes in vegetation within these headwater wetlands would provide an indication of changes in surface water runoff flows to these features and their downstream tributaries to Ray Brook.
    - Unlike for wetlands, there is not alteration option in Nova Scotia for the removal of watercourses due to flow reductions within the Nova Scotia Environment watercourse alteration program. As such, mitigation measures to maintain flows in these watercourses due to Site activities should be developed.
- As part of the proposed quarry reclamation plan, a wetland habitat is proposed to be constructed
- Section 9.1 lists anticipated residual adverse effects and does not list surface water resources. The above high-level review of drainage at the site indicates there would be potential residual effects on surface water runoff to Wetland 1 and its downstream tributary of Ray Brook and Wetland 2 and its downstream tributary to Ray Brook, which should have been included in this assessment.

Groundwater Quantity & Quality

- No discussion is provided on changes to infiltration from the existing forest land use to an active quarry flow for the proposed quarry site, or what is observed at the existing quarry site.
- Adjacent monitoring wells to the existing quarry are observed to have water levels that have not observed substantial changes between 2013 and 2018 (Section 5.3.3). The Project is stated as not expecting a significant effect on

groundwater resources.

Recommendations

Operational Issues/Other Permitting Processes

Surface Water Quality

- No aggregate washing activities should occur at the Site without permission from NSE.
- Submission of proposed dust control activities to NSE staff for review as part of the Industrial Approval application, including the proposed source of water, expected withdrawal volumes, and associated mitigation measures to reduce impacts. If water withdrawal volumes trigger requirements for a water withdrawal application, this should be prepared and submitted prior to the start of quarry construction and operation activities.
- An erosion and sediment control plan developed by a qualified professional engineer should be submitted for NSE review and approval prior to the start of construction and operation activities for the new quarry site and expanded crushing/stockpile area, including clearing, grubbing and stripping.
- New surface water management infrastructure (e.g., settling ponds, ditches, seep away) and existing infrastructure enhancements should be designed by a qualified professional engineer to reduce sediment loading from the quarry site. Enhancements should be considered for all existing drainage management infrastructure based on the observed anthropogenic sediments observed in Ray Brook as part of the fish habitat assessment. Site drainage should be developed to minimize changes in surface water runoff to existing drainage areas (e.g., Wetland 1 and 2). This infrastructure should include proposed clean water diversion berms and other drainage systems to convey non-site impacted water away from the Project area. Pre- and post-development surface water runoff rates should be considered in the design with the objective of a zero increase in peak discharge from the project development area, including seep away designs. Pond design should consider potential scour impacts to the receiving water environment. Appropriate mitigation measures should be implemented to support surface water management through all phases of project phases, including incorporating seasonality (e.g., winter site management). Final infrastructure design criteria, storm event sizing, and effluent discharge concentration and monitoring requirements should be developed and submitted to NSE staff for review and approval prior to the start of quarry construction.
- A surface water quality monitoring program should be developed to monitor discharge from the proposed surface water runoff management infrastructure, and potential effects on watercourses impacted by the project development (e.g., Wetlands 1 and 3 outlets; Ray Brook downstream of Wetland 2). A baseline monitoring site should be established on an unnamed tributary of Ray Brook that will not be affected by the Project works, if feasible. The monitoring programs should include regular TSS and pH water sample collection and analysis when drainage works are flowing to assess their adequacy in reducing sediment loads. Periodic monitoring for an expanded list of parameters such as metals, which would be potentially transported with sediment from the quarry activities should be included as part of the program. This plan should be submitted to NSE staff

for review and approval prior to the start of quarry construction.

- The existing site-specific contingency plan should be revised based on the expanded quarry operations that includes prevention and response methods for spills and inadvertent releases. This plan should be submitted to NSE staff for review and approval prior to the start of expanded quarry construction, including grubbing and clearing.

Surface Water Quantity

- The proposed water level monitoring within Wetlands 1 and 3 as proposed for the wetland monitoring program should be conducted, including baseline monitoring. Changes in water levels should be used as an alternative measurement of flow regime changes within the downstream Ray Brook tributaries. The wetland monitoring program should be submitted to NSE staff for review and approval prior to the start of expanded quarry construction, including grubbing and clearing.
    - As part of the monitoring program, mitigation measures should be proposed to maintain flows in Wetlands 1 and 3 and their downstream tributaries should flow reductions be identified (e.g., pumping treated water from sediment collection to wetlands to match previous surface water runoff inputs). The Nova Scotia Environment watercourse alteration program does not include permanent reductions in flow regimes and loss of watercourses sections as an approvable activity.

Groundwater Quality and Quantity

- The existing groundwater quality and quantity monitoring program and proposed revisions within the EA submission should be developed and implemented, including a monitoring interval for wells upgradient of the proposed quarry site to represent baseline monitoring conditions. This program should be developed in consultation with and reviewed and approved by NSE staff prior to the start of quarry construction.

From: Hearn, Scott <Scott.Hearn@novascotia.ca>
Sent: April 9, 2020 8:59 AM
To: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>; MacPherson, George E <George.MacPherson@novascotia.ca>
Subject: RE: Spicer North Mountain Quarry Expansion Project Environmental Assessment Registration

Good morning Renata,

Energy and Mines has reviewed the file for Spicer north Mountain Quarry Expansion EA registration.

We have no comments to make on this review.

Thank you,

Scott Hearn, P.Eng
Manager, Mineral Development and Policy
Geoscience and Mines Branch
Nova Scotia Department of Energy and Mines
1701 Hollis Street
2nd Floor Founders Square
PO Box 698
Halifax, NS
B3J 2T9

(F) 902-424-7735
scott.hearn@novascotia.ca

From: McKenna, Chuck W <Chuck.McKenna@novascotia.ca>
Sent: April 9, 2020 9:02 AM
To: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Subject: RE: Spicer North Mountain Quarry Expansion Project Environmental Assessment Registration

Renata,

No comments from Resource Management Unit.

Chuck

From: Finnigan, Jean-Charles <Jean-Charles.Finnigan@novascotia.ca>
Sent: April 9, 2020 10:22 AM
To: Mageste da Silva, Renata <Renata.MagestedaSilva@novascotia.ca>
Cc: Currie, Paul D <Paul.Currie@novascotia.ca>
Subject: RE: Spicer North Mountain Quarry Expansion Project Environmental Assessment Registration

Hi Renata,

Hope you're doing well in these strange times. No comments from the industrial unit.

Thanks

JC

Mageste da Silva, Renata

From: @gmail.com
Sent: March 10, 2020 2:04 PM
To: Environment Assessment Web Account
Subject: Proposed Project Comments

Project: Spicer North Mountain Quarry Expansion Project Comments: This comment concerns the significant number of breeding Canada Warblers within the site boundaries. This bird is a threatened species listed by the Species at Risk Act. The registration document notes that the breeding Canada Warblers were outside the habitat disruption that would be created by the expanded quarry area. However, the consultants do not consider the effects of noise during the breeding season. The noise levels listed in the registration document are for spaces at the boundaries of the property. The discussion of noise effects focuses on human impacts, not wildlife. The Canada Warblers on the property breed very close to the sources of noise from the project. There is a growing scientific literature on the adverse effects of industrial noise on breeding birds. There is no discussion of this literature in the document. This project should not be approved by the Minister until there are a more detailed study and consideration of the impact of noise on the Canada Warblers. Given the proximity of the Canada Warbler habitat to the expanded quarry site, I assess that there is considerable risk that noise levels could cause Canada Warblers to abandon their nesting territories in what is otherwise suitable habitat.
Name: Email: @gmail.com Address: