ALTO HIGH-SPEED RAIL — SOUTHERN ROUTE

POLICY BRIEF

Bat Species at Risk and the Moira Karst Hibernaculum: *Impacts, Legal Obligations, Mitigation, and Fiscal Risk*

Alto HSR Citizen Research Initiative | March 2026

EXECUTIVE SUMMARY

The Alto High-Speed Rail southern corridor passes through or in close proximity to the Moira Karst, a significant karst limestone formation in Hastings County, Ontario. Within this formation, a major solution cave has been confirmed as a multi-species hibernaculum for four bat species, all listed as Endangered under the federal Species at Risk Act (SARA) and Ontario's Endangered Species Act, 2007 (as amended by Bill 5, with the Species Conservation Act, 2025 enacted but not yet proclaimed in force as of March 2026). The confirmed species are: Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), Eastern Small-footed Myotis (Myotis leibii), and Tri-colored Bat (Perimyotis subflavus).

These species are not merely listed as endangered, they are populations in active collapse. White-nose Syndrome (WNS) has driven declines of 85–99% in Ontario's cave-hibernating bat populations since 2010. The Moira Karst cave represents an irreplaceable refugium, and the historical record indicates it supported the largest population of Little Brown Myotis in Southern Ontario prior to WNS. Any new threat to this site operates against a baseline of catastrophic fragility.

Evidence from international jurisdictions, most directly from the United Kingdom's HS2 project, demonstrates that high-speed rail construction near sensitive bat habitat triggers legal obligations that are non-negotiable and can impose costs of extraordinary scale. The Sheephouse Wood Bat Mitigation Structure on HS2, built to protect a colony of Bechstein's bat, has cost in excess of £100 million (approximately CAD $175 million at current exchange rates). A government review in 2021 determined there was no cheaper alternative.

Canada's SARA imposes hard prohibitions on harming, harassing, or killing endangered bat species, and on destroying their residences (hibernacula). These prohibitions apply automatically. Any Alto HSR project activity that would disturb the Moira Karst hibernaculum, through construction vibration, ground-borne noise, surface water disruption, or habitat fragmentation, would require a SARA s. 73 permit. The granting of such a permit is not guaranteed and requires demonstration that there is no satisfactory alternative, that all feasible mitigation has been employed, and that the species' recovery will not be jeopardized. For four species already at imminent risk of extirpation, this is an exceptionally high threshold.

This brief concludes that Alto HSR proponents must: (1) commission independent pre-consultation bat surveys and geotechnical vibration pathway assessments at the Moira Karst; (2) treat bat mitigation costs as a material budget risk, potentially in the CAD $100–200 million range based on HS2 precedent; (3) evaluate route alternatives before any permits are sought; and (4) engage ECCC Canadian Wildlife Service and Ontario MNRF at the earliest opportunity.

1. THE MOIRA KARST HIBERNACULUM AND CONFIRMED BAT SPECIES

1.1 The Moira Karst System

The Moira Karst is a karst limestone formation in Hastings County, formed through the dissolution of Paleozoic carbonate bedrock (primarily the Gasport Formation) over millions of years. The system includes the Moira Cave, one of the largest solution cave systems in eastern Ontario, with passages extending in excess of 11 km. The cave system has been documented in academic and caving literature since at least the 1960s and is noted for extensive karst topography including solution passages, pot holes, and bedding plane caves accessed at the Moira River. White-nose Syndrome was first confirmed in this cave system in 2010, reflecting its role as a significant regional bat aggregation point.

Karst systems in Ontario are geographically constrained to areas of carbonate bedrock, primarily the Niagara Escarpment and the limestone plains of eastern Ontario. The recovery strategy for Eastern Small-footed Myotis explicitly identifies "areas of eastern Ontario formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum (karst)" as the principal locations of known hibernacula for that species in the province (MECP, 2018). The Moira Karst is squarely within this description.

1.2 Confirmed Species and Their Conservation Status

Four bat species, all listed as Endangered, have been confirmed using the Moira Karst hibernaculum. Their status and key vulnerability factors are summarized below.

Species	COSEWIC / SARA Status	Ontario ESA Status	Key Threat (post-WNS)
Little Brown Myotis (Myotis lucifugus)	Endangered (2012, emerg. listing)	Endangered (2013)	WNS; 90–99% hibernaculum decline in eastern Ontario
Northern Myotis (Myotis septentrionalis)	Endangered (2012, emerg. listing)	Endangered (2013)	WNS; 94% overall decline in known hibernating populations
Eastern Small-footed Myotis (Myotis leibii)	Endangered (COSEWIC 2013)	Endangered (2014)	WNS (confirmed 2016 in Ontario); only ~10 known hibernacula in province
Tri-colored Bat (Perimyotis subflavus)	Endangered (2012, emerg. listing)	Endangered (2013)	WNS throughout entire Canadian range; 10% of global population in Canada

Sources: COSEWIC 2013; Environment and Climate Change Canada 2018; Ontario MECP 2020 Government Response Statements; Ontario COSSARO evaluations 2012–2014.

1.3 The Particular Significance of the Moira Hibernaculum

A hibernaculum's conservation value is determined not simply by the number of animals it currently contains, but by its biological function and irreplaceability. The Moira Karst cave provides several functions that cannot readily be replicated or substituted:

- Multi-species use: All four confirmed species have overlapping use of a single cave, meaning disruption affects a disproportionately large fraction of the regional endangered bat population with a single impact event.
- Historical significance: Before WNS devastated populations, this site supported what was reportedly the largest population of Little Brown Myotis in Southern Ontario. The historical population baseline makes it both a conservation priority and a legally significant site for recovery purposes.
- Limited alternatives: The recovery strategy for Eastern Small-footed Myotis emphasizes that suitable cave hibernacula are limited in Ontario because they are restricted to karst areas. With only approximately ten known hibernacula for this species in the entire province, the loss or degradation of even one is a significant recovery setback.
- Swarming function: In addition to overwintering, bat cave systems function as swarming sites in late summer/early fall, a critical reproductive and social function. Disruption to swarming habitat impairs mating success in already-depleted populations.
- Longevity and site fidelity: Bat species demonstrate strong hibernaculum site fidelity over decades. Research cited in recovery strategies notes that hibernacula have "longevity of use of decades or longer." Individual bats do not simply relocate to equivalent sites — suitable alternatives may not exist within the species' travel range.

2. HOW HIGH-SPEED RAIL CONSTRUCTION AFFECTS BATS

2.1 Habitat Loss and Fragmentation

High-speed rail corridors require substantial land clearing and grading. Construction of the Al to HSR southern corridor will remove foraging habitat, particularly forest edges, wetlands, and linear waterway corridors that endangered bat species depend upon. Research from the UK (Berthinussen & Altringham, 2012) has documented that total bat activity increases more than threefold between 0 and 1,600 m from a major transport corridor, confirming the spatially extensive nature of habitat displacement. For Myotis species, which forage at forest edges, along waterways, and within forest interiors, the removal and fragmentation of these habitats reduces access to foraging areas and increases energy expenditure per successful foraging bout.

Northern Myotis, in particular, is a forest-dependent species that forages within forest interior along edges and in gaps. The recovery strategy recommends that foraging areas within 450 m of a maternity site boundary be identified as supporting habitat — indicating the spatial footprint of sensitivity extends well beyond the physical roost.

2.2 Ground-borne Vibration and Noise at Hibernacula

Construction of high-speed rail infrastructure near a cave hibernaculum presents acute risks through ground-borne vibration pathways. Blasting, pile-driving, vibratory compaction, and heavy earthmoving operations generate vibration energy that propagates through bedrock at velocities and frequencies that can penetrate karst cave systems at significant distances. This is a particular concern in karst terrain, where fractured limestone transmits vibration along solution channels with minimal attenuation.

Research on the effects of surface mine blasting on bat hibernacula (Brown & Berry, 2000, cited in Matrix Solutions, 2015) has documented that hibernating bats can generally tolerate peak particle velocities of 1.52 to 5.08 mm/sec; however, there is a lack of literature on levels above 6.35 mm/sec. More critically, these findings relate to episodic blasting events. Rail construction introduces sustained vibration over months or years, a qualitatively different exposure profile for hibernating populations.

Laboratory and field research (Luo et al., 2014; Thomas, 1995; Journal of Experimental Biology, 2014) confirms that torpid bats are not immune to anthropogenic noise and vibration, and respond with elevated skin temperature, indicating metabolic arousal from torpor. Each such arousal has a severe energetic cost: Thomas (1995) documented that a single arousal event for Little Brown Myotis costs approximately 108 mg of fat, equivalent to the fat burned in 68 days of undisturbed torpor. For bats already entering hibernation in compromised condition due to WNS, forced arousals during winter can be directly lethal.

Merlin Tuttle (2022) notes that well before WNS, researchers had documented alarming population declines at hibernacula subject to human disturbance, and cautioned that visits to hibernacula "should be kept to a minimum." The recovery of a gray myotis colony at Pearson Cave, Tennessee, accelerated dramatically after protection from disturbance was installed — growing from 100,000 to 365,000 bats over two undisturbed survey periods. This demonstrates both the sensitivity of hibernating bats to disturbance and the capacity for recovery when threats are removed. Conversely, it illustrates the magnitude of impact that persistent disturbance, such as prolonged rail construction, could impose on an already-endangered population.

2.3 Hydrological Disruption in Karst Systems

Karst systems are particularly vulnerable to hydrological disruption because groundwater flow, temperature, and humidity within caves are controlled by surface water infiltration patterns. Rail construction involving earthworks, drainage modification, culverting of watercourses, and application of de-icing chemicals can alter the thermal regime and humidity of a connected cave system. Since hibernating bats select specific temperature zones within caves, typically 2–10°C with humidity above 80%, any disruption to these microclimate conditions can render previously suitable hibernation zones unsuitable or force bats to less optimal thermal zones with higher metabolic cost.

The Eastern Small-footed Myotis has been documented hibernating "in the coldest parts of shallow (less than 150 metres long) caves and mines," and individual records indicate this species tolerates colder, drier conditions than other hibernating bat species (MECP, 2018). However, this tolerance is calibrated to stable cave microclimate conditions, not to anthropogenically altered ones. Drainage modifications associated with rail construction could unpredictably shift the thermal and humidity envelope of the Moira Karst cave, with cascading impacts on all four species.

2.4 Light Pollution and Foraging Disruption

Construction activity extends into evening hours and involves the use of high-intensity lighting. Research has established that Myotis species, which are classified as "clutter-adapted" foragers, are among the bat species most sensitive to artificial light at night (ALAN). ALAN disrupts foraging behavior, causes bats to avoid illuminated habitat corridors, and can block access to roosting and foraging sites by introducing bright, structurally novel light barriers across commuting routes. These effects persist after construction if the operational rail corridor introduces station lighting, maintenance area lighting, or infrastructure lighting that was not previously present in the landscape.

3. HOW HIGH-SPEED RAIL OPERATION AFFECTS BATS

3.1 Train-Pass Disturbance and Foraging Suppression

A 2021 peer-reviewed study by Mathews & Jerem (University of Sussex), published in Scientific Reports, is the most directly relevant body of evidence for bat impacts during rail operation. Using ultrasonic detectors at 12 wooded rail-side sites in southern England, the researchers monitored common pipistrelle and soprano pipistrelle bats. They found that bat activity fell by at least 30–50% each time a train passed, and that recovery took at least two minutes.

Alto’s planning documents indicate departures will run generally hourly, with the potential for 30-minute intervals at peak periods — 20 to 30 trains per day in each direction (The Canadian Press, December 19, 2025). At those headways, each two-minute suppression event is less continuous than on the busiest conventional lines studied by Mathews & Jerem. However, two compounding factors raise the concern: first, high-speed trains travelling at 300 km/h generate considerably greater broadband noise and vibration per pass than the conventional trains in the study, meaning each disturbance event is likely more severe; second, the EUROBATS guidance document (2024) notes that even on moderately trafficked lines, activity suppression accumulates significantly across a foraging night. For populations already depleted 85–99% by White-nose Syndrome, the energetic cost of repeated forced evasive responses, even at lower frequency, leaves no margin. This is a potential population-level stressor.

Prof. Mathews stated that "at the moment, no consideration is given to the ecological impacts of increased railway traffic," and that appropriate mitigation could include "setting aside larger buffer areas adjacent to railways, reducing the impact on bats." These are measures that must be designed into the project from the outset, not retrofitted.

3.2 High-Speed Train Noise and Vibration During Operation

High-speed trains generate considerably higher intensity broadband noise and vibration than conventional rail traffic (Jerem & Mathews, 2021; EUROBATS, 2024). This is due to their greater speed and mass. Ground-borne vibration from operational high-speed trains is transmitted through the substrate at varying levels depending on train speed, track type, geological substrate, and distance. In a karst limestone substrate, which transmits vibration efficiently through fractured bedrock, operational vibration from a nearby HSR line may reach a connected cave hibernaculum at levels sufficient to cause periodic arousal from torpor throughout the five-to-six-month hibernation period.

The cumulative energy cost of repeated, sub-lethal arousals across a hibernation season is potentially catastrophic for populations already stressed by WNS. The research literature on the fat cost of arousal events is unambiguous: Thomas (1995) documented that each arousal of Little Brown Myotis costs the equivalent of 68 days of torpor. A winter hibernation period of approximately 180 days provides very limited energetic margin. WNS-affected bats have already been found to exhaust fat reserves in January or February rather than March or April, operational HSR vibration would impose additional arousal pressure on populations already at the physiological edge.

3.3 Barrier Effects and Population Fragmentation

High-speed rail lines function as significant barriers to bat movement. Unlike conventional railway lines, which bats may occasionally cross at grade-level openings, high-speed rail infrastructure typically includes extensive fencing, noise barriers, grade separation structures, and catenary infrastructure that creates a physically and perceptually impermeable linear barrier. Research from Sweden (Kammonen, 2015, cited in SpringerLink, 2017) found that parallel motorway and railway infrastructure acted as a barrier for Myotis bat species, with animals using only green bridges or underpasses to cross.

For the Moira Karst bat populations, which must move between the hibernaculum and summer foraging and maternity habitats seasonally, a high-speed rail line severing commuting corridors could isolate the hibernaculum from productive summer range. This is particularly significant given that all four species affected are poor colonizers of new territories — their low reproductive rates (typically one pup per female per year) and strong site fidelity mean that population fragmentation is a direct extinction risk rather than a manageable inconvenience.

3.4 Collision Mortality

Bat mortality through train collisions is documented but poorly quantified, as detection is significantly more difficult on rail lines than on roads (SpringerLink, 2017). One study suggested that lower night-time rail traffic volumes may reduce collision risk by approximately two-thirds compared to roads (Pakula & Furmankiewicz, 2021); however, this relationship does not apply straightforwardly to high-speed rail where speeds are substantially higher. Peak bat collision risk occurs in summer and autumn, when juvenile bats are beginning their first independent flights, populations are at annual maximums, and insect availability is highest near infrastructure. For species as rare as the confirmed Moira Karst species, even small increments in annual adult mortality, estimated at 5% per colony, would be unsustainable (EUROBATS, 2024).

4. INTERNATIONAL EXPERIENCE: WHAT HAS HAPPENED IN OTHER JURISDICTIONS

4.1 United Kingdom — HS2 (High Speed 2)

HS2, the United Kingdom's in-progress high-speed rail project connecting London to Birmingham and beyond, provides the most detailed and directly relevant international case study for bat impacts from high-speed rail. The HS2 experience demonstrates unequivocally that proximity to protected bat species triggers legal obligations that are non-negotiable and that mitigation costs can be extraordinary.

Sheephouse Wood, located in Buckinghamshire between Bicester and Aylesbury, contains habitat for Bechstein's bat (Myotis bechsteinii), a woodland-specialist species with fewer than ten breeding colonies in England. Early ecological surveys in the late 2000s identified the presence of this species in the Bernwood Forest landscape, which includes Sites of Special Scientific Interest, ancient woodland, and designated bat habitat. UK law (under the Conservation of Habitats and Species Regulations 2017) requires that infrastructure proponents demonstrate that protected bat populations will remain in "favourable conservation status within their natural range", a test analogous to the SARA s. 73(3) preconditions in Canada.

The Sheephouse Wood Bat Mitigation Structure (SWBMS) is the result: a 900-metre-long, up to 10-metre-high steel mesh arch structure designed to completely enclose the railway as it passes through bat habitat, preventing any bat-train interaction while preserving the canopy-level foraging corridor used by the Bechstein colony. The structure is four tracks wide (accommodating both HS2 and East West Rail), must withstand concurrent train derailments, passively ventilate, and is designed for a 120-year service life. It includes a green bridge for continued wildlife movement.

The cost of this single bat mitigation structure has risen to in excess of £100 million (HS2 Ltd, November 2024), or approximately CAD $175 million. A 2021 review by the UK Department for Transport, DEFRA, and Natural England, specifically examining whether any cheaper alternative existed, concluded that it did not (HS2 FAQ, 2024). The legal firm Herbert Smith Freehills (2025), analyzing the structure in the context of environmental permitting, noted that "if HS2 couldn't have shown that the Bechstein bat colony would stay in favourable conservation status, they simply could not have built the line through Sheephouse Wood. They had to offer up mitigation, however expensive that was."

HS2's total approved bat-related consenting requirements numbered in the dozens, as the project required 8,276 individual consents from public bodies for the London-Birmingham section, a substantial proportion of which related to protected species including multiple bat species. The CIEEM (Chartered Institute of Ecology and Environmental Management) noted in January 2026 that the SWBMS "has forced difficult trade-offs — between design efficiency, legal compliance, and ecological function," and that "development and nature must go hand-in-hand."

4.2 California High-Speed Rail

The California High-Speed Rail (CHSR) project, authorized by voters in 2008, operates under a Programmatic Agreement with the U.S. Fish & Wildlife Service (USFWS) under Section 7 of the U.S. Endangered Species Act (ESA). Like SARA, the U.S. ESA requires federal project proponents to demonstrate that their actions will not jeopardize the continued existence of listed species. When species or habitats are adversely impacted, CHSR must protect comparable habitat to compensate, known as Permittee Responsible Mitigation (PRM) sites. To date, CHSR has purchased more than 600 acres of mitigation habitat for a single species (California tiger salamander), with additional sites protecting San Joaquin kit fox and other listed species. The USFWS works in ongoing Section 7 consultation on the project as its environmental footprint continues to expand (USFWS, 2022).

While CHSR does not have a direct bat structure analog to HS2's SWBMS (California bat species differ substantially from those in eastern Ontario), the project demonstrates that large linear infrastructure in North America is subject to rigorous and costly species-at-risk mitigation regimes that extend throughout the construction period and into operations.

4.3 European Rail Guidance

The EUROBATS Agreement, an intergovernmental agreement under the Convention on Migratory Species to which Canada is not party but whose guidance is scientifically authoritative, has produced comprehensive guidance on bat impacts from traffic infrastructure. The EUROBATS guidance document (Advisory Committee document AC27.4, 2024 draft) synthesizes decades of road and rail ecology research and explicitly notes that "the scale of such projects [rail and airport construction] should trigger a strict environmental impact assessment process." It further notes that "there is a need for transport commissioning authorities to work with researchers to better understand how traffic infrastructure and operation affect bat behaviour, and impact bats at the population level." The EUROBATS guidance recommends pre-project bat surveys at project-specific scales, independent vibration pathway assessments for hibernacula, and post-construction monitoring programs — all elements that are currently absent from Alto's planning process.

5. CANADIAN LEGAL FRAMEWORK

5.1 Federal Species at Risk Act (SARA)

SARA's prohibitions are the primary federal legal constraint on Alto HSR activities near the Moira Karst hibernaculum.

- Section 32: No person shall kill, harm, harass, capture or take an individual of a wildlife species listed as an extirpated, endangered or threatened species. All four Moira Karst bat species are listed as Endangered on Schedule 1 of SARA.
- Section 33: No person shall damage or destroy the residence of one or more individuals of a listed endangered or threatened species. A hibernaculum, a cave or mine used by

bats for overwintering, is explicitly recognized in SARA guidance as a "residence" (a dwelling place habitually occupied during part of an individual's life cycle, including hibernating).
- Section 58(1): No person shall destroy any part of the critical habitat of a listed endangered or threatened species. Critical habitat for these bat species has been identified in recovery strategies as including hibernacula, swarming sites, maternity roosts, and foraging habitat within specified buffer distances.

Construction vibration causing arousal of hibernating bats, destruction or alteration of the cave microclimate through hydrological disruption, clearing of foraging habitat within buffer distances, or light/noise impacts that impair foraging success are all activities that could constitute harm or harassment under s. 32, or destruction of a residence under s. 33. A SARA permit under s. 73 would be required before any such activities could lawfully proceed.

Section 73(3) of SARA sets out three preconditions for permit issuance that must all be satisfied: (a) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted; (b) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and (c) the activity will not jeopardize the survival or recovery of the species. For species facing >90% population declines and functional extirpation timelines modelled in years to decades, satisfying precondition (c) is an extremely high bar.

5.2 Ontario Provincial Law: ESA 2007 (Amended) and the Species Conservation Act, 2025

Ontario's provincial species-at-risk framework is in active transition and this has direct implications for the Moira Karst bat populations. Three layers must be understood together.

The Endangered Species Act, 2007 (ESA) remains the operative provincial statute as of March 2026. All four Moira Karst bat species are listed as Endangered on Ontario's Species at Risk in Ontario (SARO) list and automatically protected. However, Ontario's Bill 5 (Protect Ontario by Unleashing our Economy Act, 2025, S.O. 2025, c. 4, Royal Assent June 5, 2025) made immediate amendments to the ESA that significantly affect the scope of provincial habitat protection. Most critically, the amended ESA narrows the definition of "habitat" to a species' physical dwelling place and the area immediately surrounding it that is essential for breeding, rearing, overwintering, or similar functions. This eliminates the previously automatic provincial protection for broader foraging areas, movement corridors, and seasonal habitats that the original ESA protected through its General Habitat Description framework.

This narrowing has direct consequences for the Moira Karst bat populations. Recovery strategies published under the original ESA recommended the following foraging habitat buffers as supporting habitat: 2,400 m of the maternity site boundary for Little Brown Myotis; 450 m for Northern Myotis; 920 m for Tri-colored Bat; and 610 m around all hibernacula and swarming sites for Eastern Small-footed Myotis (MECP, various dates). Under the amended ESA's narrowed habitat definition, the automatic provincial protection for these foraging buffer areas is no longer clear. The hibernacula themselves, as the bats' immediate dwelling places — retain protection, but the broader landscape context that makes those hibernacula viable is now more vulnerable provincially. This does not reduce the urgency of protection; it shifts greater responsibility onto the federal SARA framework.

The Species Conservation Act, 2025 (SCA), enacted as Schedule 10 of Bill 5, will replace the ESA entirely once proclaimed in force. As of March 2026, enabling regulations are still being finalized and the SCA has not been proclaimed. When it comes into force, the SCA will further exclude migratory birds and aquatic species from provincial authorization requirements, deferring entirely to SARA for those groups. The SCA also moves toward a registration-first authorization model intended to streamline approvals. Environmental law practitioners have noted that the SCA operative protections are substantively weaker than the original ESA, particularly regarding habitat scope (Ecojustice; JFK Law, 2025).

5.3 Application to Alto HSR: SARA as the Primary Protection Layer

The combined effect of Bill 5's ESA amendments and the forthcoming SCA is to make SARA the primary, and increasingly the sole, substantive legal protection for the Moira Karst bat species at the provincial level. This has a direct and significant implication for the SARA s. 34 analysis applicable to Alto HSR.

Under SARA s. 34, the federal prohibitions in ss. 32 and 33 do not automatically apply on non-federal provincial lands unless the competent federal minister forms the opinion that provincial law does not effectively protect the species. Under the original ESA, Ontario's broader habitat protections made it arguable that provincial law was effective. Following Bill 5's narrowing of the habitat definition and the eventual removal of separate provincial authorization requirements for bats (which are not aquatic species or migratory birds protected under the Migratory Birds Convention Act, and therefore fall under provincial jurisdiction absent a s. 34 order), the question of whether Ontario law now "effectively protects" these bat species, particularly their foraging and movement habitat outside the immediate hibernaculum, is a live legal question that has not been publicly resolved. If ECCC determines that provincial law is no longer effective, the federal government would be required to recommend a s. 34 order extending SARA prohibitions to provincial lands, significantly broadening the regulatory footprint of any Alto HSR permit application.

Regardless of how the s. 34 question is resolved, SARA's protections apply automatically on all federal lands, including any Crown rights-of-way acquired by Alto HSR, and apply to all four bat species as SARA-listed Endangered species wherever they are found on federal land. Alto HSR cannot proceed through or in proximity to the Moira Karst hibernaculum without engaging the Canadian Wildlife Service (Environment and Climate Change Canada) and Ontario MNRF at pre-application consultations, commissioning comprehensive bat surveys, and — if the project cannot avoid impacts, applying for and obtaining permits under SARA and under the applicable Ontario provincial instrument (currently the amended ESA, potentially the SCA by the time permits are sought). Each of these processes takes time and carries genuine risk of denial or imposition of mitigation conditions that materially affect project design and cost.

6. CAN PROBLEMS BE MITIGATED? METHODS AND COSTS

6.1 Avoidance — The Priority Measure

Both SARA (s. 73(3)(a)) and sound ecological practice require that avoidance of impact be considered before mitigation. In the context of the Moira Karst hibernaculum, avoidance means route alignment that maintains sufficient separation from the cave system that construction vibration, hydrological disruption, and operational disturbance cannot reach the hibernaculum at biologically significant levels. What constitutes "sufficient separation" depends on geological vibration pathway analysis, which has not yet been conducted for this site. Given the efficient transmission of vibration through fractured karst limestone, distances that would be adequate for non-karst substrates may be insufficient here. Route selection must be informed by site-specific geotechnical investigation.

6.2 Known Mitigation Measures

Where avoidance is not feasible, the following mitigation measures have been applied or proposed in analogous situations internationally. Each carries significant cost and uncertainty:

- Structural exclusion structures (bat tunnels/arches): As demonstrated by HS2's Sheephouse Wood Bat Mitigation Structure, a purpose-built enclosure over the railway track can prevent bat-train interaction in critical habitat sections. Cost: £95–100+ million (CAD $165–175 million) for a 900 m structure over one habitat parcel. The Moira Karst context differs (it is a hibernaculum rather than a foraging/commuting corridor), but the principle of structural enclosure to create a light- and noise-attenuated zone around the railway may apply.
- Vibration attenuation at source: Specialized track designs including resilient rail fastenings, floating slab track systems, and vibration-absorbing substructure can reduce ground-borne vibration transmission. These are engineering measures applied at the track level and significantly increase track construction cost. Floating slab track systems cost approximately 5–10× the cost of conventional ballasted track per kilometre.
- Wildlife crossing infrastructure: Green bridges, bat gantries, and underpasses can preserve commuting and foraging connectivity across the rail corridor, reducing the barrier effect. The HS2 SWBMS incorporates a green bridge as an integral element. Canadian experience with wildlife crossing infrastructure (primarily for large mammals) suggests costs of CAD $2–15 million per structure, with bat-specific crossing infrastructure requiring additional design investment.
- Hibernaculum protection gates: Where a hibernaculum is at risk from inadvertent human access (spreading WNS) or microclimate disturbance, installation of gated bat-compatible entries can reduce direct disturbance. Gates that allow air circulation while excluding human access are a standard conservation tool, but they do not address vibration or hydrological impacts from external construction.

- Habitat creation and enhancement: Provision of supplementary foraging habitat, planting of bat-friendly vegetation, installation of bat boxes, and management of land adjacent to hibernacula can offset some reduction in habitat quality. However, for hibernacula specifically, there are no effective substitutes, bats use specific caves because of their unique thermal and humidity characteristics, and artificial bat hibernacula have had extremely limited success.
- Noise barriers and lighting controls: Mitigation of operational train noise and light through purpose-designed noise barriers and directed lighting can reduce suppression of bat foraging activity adjacent to the rail corridor. Cost varies significantly by length and specification; typical transportation noise barriers cost CAD $1–4 million per kilometre.

6.3 Limitations of Mitigation

The HS2 case illustrates a fundamental reality: mitigation measures for protected bat species near high-speed rail are enormously expensive, technically complex, and subject to legal challenge. The UK's independent review process for the SWBMS assessed four viable engineering options and found the least-costly option that satisfied legal requirements still cost over £95 million. Natural England, the UK's wildlife regulator, stated that there was "ample evidence" that a high-speed train line affects bats including some of the world's rarest species.

More fundamentally, the effectiveness of most bat mitigation measures is poorly documented. The EUROBATS guidance explicitly notes that "monitoring of mitigation often lacks the rigour and time needed to demonstrate the effectiveness of different types of mitigation." For a project affecting four Endangered species at a site already stressed to near-collapse by WNS, the burden of demonstrating that mitigation will maintain favourable conservation status is essentially unprecedented in a Canadian context.

Some scenarios cannot be mitigated at any reasonable cost. If the Moira Karst cave system lies within the vibration transmission zone of a proposed rail alignment, and the species present cannot tolerate the disturbance that would result from construction, SARA s. 73(3)(c), the prohibition on jeopardizing species survival or recovery, may make it impossible to grant a permit at all. In that case, the legally mandated response is route modification, not mitigation design. This is the central lesson of HS2 at Sheephouse Wood: "if HS2 couldn't have shown that the Bechstein bat colony would stay in favourable conservation status, they simply could not have built the line through Sheephouse Wood."

7. KEY FINDINGS AND RECOMMENDATIONS

7.1 Key Findings

- The Moira Karst hibernaculum contains four SARA-listed Endangered bat species, all of which are at active risk of extirpation. This is not a precautionary designation — populations have declined 85–99% in eastern Ontario since 2010.
- Rail construction and operation present multiple, partially independent pathways of impact on cave-hibernating bat populations: ground-borne vibration, hydrological

disruption, habitat loss and fragmentation, light pollution, foraging suppression, and direct collision mortality.

- International evidence, most directly from HS2, confirms that high-speed rail near protected bat habitat triggers non-negotiable legal obligations and can impose mitigation costs exceeding CAD $175 million for a single species at a single location.
- Canadian law (SARA ss. 32, 33, 58; Ontario ESA as amended by Bill 5) prohibits harming, harassing, or destroying the residences of all four confirmed species. SARA's protections are automatic on federal lands and may extend to provincial lands via s. 34 if Ontario's amended provincial law is found not to effectively protect the species. Bill 5's narrowing of provincial habitat protection makes that question increasingly live. No exemption exists for infrastructure projects. A SARA s. 73 permit must be obtained before any project activity that would contravene these prohibitions, and permit issuance is contingent on satisfying a high legal threshold.
- The specific combination of factors at the Moira Karst, four Endangered species, historic significance, karst substrate, near-complete previous WNS devastation, means that the regulatory threshold for project approval in this area is exceptionally demanding.
- Alto's publicly stated budget range of CAD $60–90 billion does not appear to incorporate bat mitigation costs at a level commensurate with HS2 precedent. This represents a material budget risk that has not been publicly disclosed.

7.2 Recommendations to Alto HSR and the Federal Government

- Commission independent pre-consultation bat surveys: Conduct multi-season acoustic monitoring, hibernaculum counts, and species-specific population assessment at the Moira Karst cave system and surrounding landscape, covering all four confirmed species. Surveys should conform to ECCC and Ontario MNRF survey protocols for Endangered bats. This work should be underway before any route selection is finalized.
- Commission independent geotechnical vibration pathway assessment: Engage a qualified geotechnical engineer specializing in karst terrain to assess ground-borne vibration transmission from the proposed corridor to the Moira Karst cave system, including modelling of construction-phase and operational-phase vibration at hibernaculum depth. This assessment is a prerequisite to meaningful impact evaluation.
- Conduct route alternatives analysis: SARA s. 73(3)(a) requires that all reasonable alternatives that would reduce impacts have been considered. This analysis must be documented before any SARA permit application is made. Alternative alignments that maintain greater separation from the Moira Karst system, or that transit the region through existing disturbed corridors, must be formally evaluated.
- Engage ECCC Canadian Wildlife Service and Ontario MNRF at pre-consultation: Early engagement with the federal and provincial wildlife regulators is essential for understanding the scope of regulatory requirements, the likely conditions of any permit, and the timeline implications for project delivery.
- Incorporate bat mitigation as a material budget risk: Alto project budgets should include a bat mitigation cost scenario based on HS2 precedent, a minimum of CAD $100–200

million, for the Moira Karst section. This cost should be disclosed in all public consultations and project budgets.

- Establish a WNS decontamination protocol for any site access: Any researcher, contractor, or project personnel accessing the Moira Karst cave system for survey purposes must follow the Canadian National White-nose Syndrome Decontamination Protocol. Inadvertent spread of Pseudogymnoascus destructans from an infected hibernaculum to the Moira Karst would constitute harm under SARA.
- Require comprehensive bat impact assessment as part of the Environmental Impact Statement: The EIS for Alto HSR must address bat species at risk as a distinct and detailed topic, with site-specific analysis of each known and potential hibernaculum, maternity roost, and critical foraging habitat within the project corridor.

8. CONCLUSION

The four Endangered bat species confirmed in the Moira Karst hibernaculum, Little Brown Myotis, Northern Myotis, Eastern Small-footed Myotis, and Tri-colored Bat, represent some of the most precarious wildlife populations in Ontario. They are surviving in a site that is legally protected, ecologically irreplaceable, and geologically unique, against a backdrop of catastrophic WNS-driven decline. Ontario's Bill 5 reforms have narrowed provincial habitat protections and are shifting species authorization toward a streamlined framework — making the federal SARA framework more, not less, important as the primary safeguard for these species. The Alto HSR southern route, as currently proposed, has not publicly addressed this risk.

The international record, from HS2's £100 million bat tunnel to the California HSR's ongoing Section 7 consultation obligations,vis unambiguous: high-speed rail near sensitive bat habitat triggers real, legally binding, and fiscally material obligations. Canada's SARA provides no weaker protections. The consequences of proceeding without addressing the Moira Karst bat risk are not merely environmental, they include potential legal challenge, project delay, permit denial, and the imposition of mitigation costs that have not been reflected in any public Alto HSR budget estimate.

The Alto HSR Citizen Research Initiative calls on federal and provincial decision-makers to require a full, independent assessment of bat species at risk impacts on the southern route before route selection is finalized, and to ensure that the public and affected communities have access to the results of that assessment before the April 24, 2026 public consultation deadline.

REFERENCES AND SOURCES

Federal and Provincial Government Documents

Environment and Climate Change Canada (ECCC). (2018). Recovery Strategy for the Little Brown Myotis (Myotis lucifugus), the Northern Myotis (Myotis septentrionalis), and the Tri-colored Bat (Perimyotis subflavus) in Canada. Species at Risk Act Recovery Strategy Series. Ottawa: Environment and Climate Change Canada.

Government of Canada. (2012). Technical Summary: Little brown myotis (Myotis lucifugus) emergency assessment. Ottawa: COSEWIC / Environment Canada.

Government of Ontario, Ministry of the Environment, Conservation and Parks (MECP). (2020). Government Response Statement for the Recovery of Little Brown Myotis, Northern Myotis and Tri-colored Bat. Toronto: Queen's Printer for Ontario.

Government of Ontario, Ministry of Natural Resources and Forestry (MNRF). (2018). Government Response Statement for the Recovery of Eastern Small-footed Myotis. Toronto: Queen's Printer for Ontario.

Government of Ontario. (2017). Recovery Strategy for the Eastern Small-footed Myotis (Myotis leibii) in Ontario. Species at Risk in Ontario Recovery Strategy Series. Toronto: Queen's Printer for Ontario.

Government of Ontario. (2023). Review of Progress Towards the Protection and Recovery of Ontario's Species at Risk: Eastern Small-footed Myotis, 2007–2022. Toronto: Queen's Printer for Ontario.

Government of Ontario, COSSARO. (2012). COSSARO Candidate Species at Risk Evaluation for Eastern Small-footed Myotis (Myotis leibii). Toronto: COSSARO.

Species at Risk Act, S.C. 2002, c. 29. ss. 32, 33, 34, 58, 73.

Endangered Species Act, 2007, S.O. 2007, c. 6 (as amended by Bill 5, Protect Ontario by Unleashing our Economy Act, 2025, S.O. 2025, c. 4, Schedule 2, in force June 5, 2025).

Species Conservation Act, 2025, S.O. 2025, c. 4, Schedule 10 (enacted June 5, 2025; not yet proclaimed in force as of March 2026; enabling regulations under consultation).

BLG (Borden Ladner Gervais). (May 2025). Ontario aims to overhaul regulatory requirements for critical infrastructure and mining projects under Bill 5. blg.com.

Ecojustice / CBC News. (April 2025). Ontario is scaling back species at risk protections. cbc.ca/news/science/ontario-species-at-risk-changes-1.7522227.

JFK Law (Olthuis Kleer Townshend). (June 2025). Ontario's Species Conservation Act, 2025: Conflicts will be aplenty regarding Environmental Protection, Major Projects and Indigenous Rights. jfklaw.ca.

Blakes (Blake, Cassels & Graydon LLP). (October 2025). Ontario Proposes Significant Changes to the Forthcoming Species Conservation Act, 2025. blakes.com.

Permits Authorizing an Activity Affecting Listed Wildlife Species Regulations, SOR/2013-91.

Scientific Literature

Berthinussen, A. & Altringham, J.D. (2012). The effect of a major road on bat activity and diversity. Journal of Applied Ecology, 49(1), 82–89.

Brown, W.A.B. & Berry, R. (2000). An assessment of the effects of surface mine blasting on bat hibernaculum. Report for U.S. Bureau of Land Management. [Cited in Matrix Solutions Inc. 2015]

Bunkley, J.P. & Barber, J.R. (2015). Anthropogenic noise alters bat activity levels and echolocation calls. Global Ecology and Conservation, 3, 62–71.

EUROBATS Advisory Committee. (2024 draft). Inf.AC27.4: Guidance on the consideration of bats in traffic infrastructure projects. Bonn: EUROBATS/UNEP.

Jerem, P. & Mathews, F. (2021). Passing rail traffic reduces bat activity. Scientific Reports, 11, 20590.

The Canadian Press. (December 19, 2025). Up to 72 daily high-speed trains planned for Toronto–Quebec City corridor. CTV News. ctvnews.ca/canada/article/torontoquebec-city-high-speed-rail-could-see-dozens-of-daily-trains-documents/ [Alto spokesperson confirms 20–30 trains per day in each direction; generally hourly departures, potential 30-minute peak intervals.]

Journal of Experimental Biology. (2014). Are torpid bats immune to anthropogenic noise? J. Exp. Biol., 217(7), 1072–1078.

Luo, J., et al. (2014). Bats, even those in torpor, can be sensitive to high-frequency sounds. Referenced in Frontiers in Conservation Science (2025) re cave-roosting bat disturbance.

Matrix Solutions Inc. (2015). Review of Potential Noise and Vibration Effects to Bats. Appendix B2.3.3-2, Environmental Assessment document for Elk Valley Coal, British Columbia.

Schorcht, W., et al. (cited in EUROBATS 2024). Annual mortality of 5% of a colony would be unsustainable and is possible since a large proportion of the colony may be concentrated in a relatively small area at certain times of the year.

Thomas, D.W. (1995). Hibernating bats are sensitive to nontactile human disturbance. Journal of Mammalogy, 76(3), 940–946.

Tuttle, M.D. (2022). How disturbance harms hibernating bats. Merlin Tuttle's Bat Conservation. [Online resource, accessed March 2026]

HS2 and International Infrastructure Sources

Chartered Institute of Ecology and Environmental Management (CIEEM). (January 2026). HS2's Bat Mitigation Structure: Why it exists and what it means. Blog post by D. Prŷs-Jones MCIEEM. cieem.net.

Herbert Smith Freehills Kramer. (December 2025). Project Nutcracker: Avoiding more kittiwake hotels and bat sheds. hsfkramer.com.

HS2 Ltd. (2024). Sheephouse Wood bat protection structure – FAQ. HS2 Media Centre. mediacentre.hs2.org.uk.

U.S. Fish & Wildlife Service. (2022). Protecting Species in the Path of California's New High-Speed Train. fws.gov.

Cave, Karst, and Bat Natural History Sources

Conserve Wildlife Foundation of New Jersey. (2021). Eastern small-footed myotis species profile. conservewildlifenj.org.

Fisher, J.D. (1986). Karst Geomorphology at Moira River, Ontario. Bachelor's thesis, McMaster University. MacSphere repository.

Gordon, M. (n.d.). Caving in Ontario: Exploring Buried Karst. [Referenced in Caving News, August 2014.]

Mindat.org. Moira River, Thurlow Township, Hastings County, Ontario — mineral locality notes re cave system. mindat.org (accessed March 2026).

ON Nature Magazine. (2025). Bat Guide: Species profiles for Ontario's bat species at risk. onnaturemagazine.com.

Parks Canada. (n.d.). Bats: Little brown myotis and northern myotis. Jasper National Park species profile. parks.canada.ca.

The Land Between. (n.d.). Northern Myotis — Species At Risk in The Land Between. thelandbetween.ca.

Rockwatching (Gordon, M.). (2010–2012). Marmora Cave, Moira Karst, and White Nose Syndrome. rockwatching.wordpress.com.