ENVIRONMENTAL IMPACT ASSESSMENT

ALTO High-Speed Rail Project

Impacts on the Frontenac Arch

Prepared for Public Consultation by Andrew Hyett, reviewed by Rena Upitis
ALTO HSR Citizen Research Initiative
| March 2026 |

Executive Summary

This Environmental Impact Assessment evaluates potential impacts of the proposed ALTO High-Speed Rail project on the Frontenac Arch, Canada's most biodiverse region and the critical ecological corridor connecting Algonquin Park in Ontario to the Adirondack Mountains in New York State. Between Ottawa and Peterborough, ALTO is studying two corridor options: a northern corridor broadly following Highway 7, and a southern corridor crossing the narrowest portion of the Frontenac Arch.

Key findings: A route through the southern corridor is more ecologically damaging to the Frontenac Arch's core connectivity function than a route through an alternative corridor would be. The Frontenac Neck (km 42–68.5) is not a transition zone, it is the narrowest point at which the Shield wildlife corridor exists within the Biosphere, flanked by Sydenham Lake, Opinicon Lake, and the Rideau Canal. A fenced, electrified HSR corridor through this terrain would not merely add a barrier to the landscape: it would convert an existing, functioning, nationally designated wildlife and recreation corridor into one of the most impermeable linear barriers ever introduced into the Frontenac Arch. Simultaneously, it would destroy 78.2 km of Trans Canada Trail and require major intervention in the Rideau Canal UNESCO World Heritage corridor at Chaffeys Lock.

1. The Frontenac Arch Biosphere Reserve: Ecological Profile

1.1 Geological and Ecological Context

The Frontenac Arch is an ancient granite ridge, over one billion years old, connecting the Canadian Shield to the Adirondack Mountains via the Thousand Islands. It is the last intact forest corridor in eastern North America, where five forest regions converge: Boreal, Great Lakes-St. Lawrence, Carolinian, Atlantic Coast, and Appalachian. The Haudenosaunee call it the 'backbone of the mother', the structural spine sustaining living systems across the region.

The Cataraqui Trail's km 42–68.5 section traverses the geographic expression of this geological feature at its most constricted, the "Frontenac Neck". The trail authority's own documentation states: 'From Chaffey's Lock (km 42) to Eel Bay (km 68.5) on Sydenham Lake, the trail traverses a neck of the Canadian Shield known as the Frontenac Axis. This links the vast Shield country to the north with its smaller but most impressive southern extremity, the Adirondack region.' The corridor narrows here because Sydenham Lake, Opinicon Lake, and the Rideau Canal system constrain available land to a thin strip of Shield terrain, precisely where wildlife movement between north and south must concentrate.

1.2 Designation and Governance

The Frontenac Arch Biosphere Reserve was designated by UNESCO under the Man and the Biosphere (MAB) Programme in 2002 and re-designated in 2022 following a community-led nomination. It is one of 19 UNESCO Biosphere Regions in Canada, administered by the Frontenac Arch Biosphere Network (FABN) with over 100 regional partners. Its total area is 220,973 hectares, comprising a core area of 5,073 hectares, buffer zones of 15,900 hectares, and transition areas of approximately 200,000 hectares. Canada's MAB obligations require protection of three core functions: conservation of biological and cultural diversity; ecologically sustainable development; and logistical support for research, monitoring, education, and knowledge exchange.

1.3 The Cataraqui Trail as an Existing Ecological Corridor

Before assessing impacts, it is essential to recognize what the Cataraqui Trail currently represents ecologically. The former CN Railway right-of-way, with its low-disturbance gravel surface, absence of motorized traffic (except seasonal snowmobiles on some sections), and associated hedgerows, wetland margins, and rock cuts, functions as a permeable linear movement corridor through the Biosphere. Wildlife moving north and south through the Arch use this corridor. Field observers on the Frontenac Neck section routinely encounter Gray Ratsnakes on the warm rock cuts, Blanding's Turtles crossing between wetlands, and Eastern Whip-poor-wills calling from adjacent barrens. The wetland density described by recreational users, multiple ponds, open-water marshes, and small lakes within every few kilometres of trail, reflects the ecological richness of this intact former railway corridor.

Converting this permeable corridor to a fenced, electrified, 300 km/h HSR corridor would not just add a new barrier to the landscape: it would destroy an existing ecological asset and replace it with one of the most impermeable barriers that could be introduced into the Biosphere.

1.4 Key Biodiversity Areas Within the Biosphere

Three Key Biodiversity Areas (KBAs) are formally identified within the Frontenac Arch Biosphere Region:

- Thousand Islands KBA (2025): At the continental pinch-point where the Arch crosses the St. Lawrence River. Also nationally designated as an Important Area for Reptiles and Amphibians (IMPARA). Contains almost the entire Canadian population of Deerberry, over 10% of Canada's Pugnose Shiner, and critical habitat for Gray Ratsnake, Blanding's Turtle, and Pitch Pine.
- Charleston Lake KBA: Centered on Charleston Lake Provincial Park in Leeds and Grenville County. Supports rare fire barren communities, Bear Oak, and high concentrations of Blanding's Turtle. The Cataraqui Trail's western limestone section passes through the landscape connecting to this KBA.
- Frontenac Forests KBA: Encompasses the upland forest complexes of Frontenac County, including Frontenac Provincial Park and the Queen's University Biological Station (over 200 bird species recorded). The Cataraqui Trail's Frontenac Neck section runs through the linkage zone connecting the Frontenac Forests KBA to the Thousand Islands KBA, it is the ecological connector between these two nationally significant areas.

A fourth KBA, the Napanee Limestone Plain, is in the process of being proposed. The Cataraqui Trail's Napanee Plain section (km 68.5–103) crosses directly through the karst terrain that would form part of this proposed KBA.

2.5 Species at Risk Profile

The Frontenac Arch Biosphere supports more than 50 threatened and endangered species. The following are most directly relevant to the Cataraqui Trail corridor:

Reptiles and Amphibians

- Gray Ratsnake (Pantherophis spiloides), Frontenac Axis population: Threatened under SARA and Ontario's ESA. Ontario's largest snake. The Frontenac Neck section of the Cataraqui Trail runs through the core of the Frontenac Axis population's range. SARA critical habitat is designated and mapped throughout this zone; the habitat regulation protects all occurrence sites and a 1,000-metre buffer. The warm rock cuts, embankments, and forest edges of the former railbed are precisely the microhabitat features, thermoregulation sites, egg-laying substrates, communal basking locations, that the SARA habitat regulation is designed to protect.
- Blanding's Turtle (Emydoidea blandingii): Threatened under SARA. Undertakes long-distance terrestrial movements between wetlands and nesting sites. The dense wetland network of the Frontenac Neck (km 42–68.5) is prime Blanding's Turtle habitat. Adult mortality rates need only increase by a small number of individuals per year to push local populations below viability thresholds given this species' extremely low reproductive rate.
- Wood Turtle (Glyptemys insculpta): Endangered under SARA. Present in the Salmon and Napanee watershed headwaters draining the Frontenac Neck and Napanee Plain sections.
- Five-lined Skink (Plestiodon fasciatus): At its eastern Ontario northern range limit; dependent on warm granite habitats that characterize the Frontenac Neck terrain.

Avifauna

- Cerulean Warbler (Setophaga cerulea): Nationally Endangered. Requires mature deciduous forest interior. The Frontenac Neck supports breeding habitat; HSR fragmentation would reduce interior forest area and increase edge effects.
- Eastern Whip-poor-will (Antrostomus vociferus): Threatened under SARA. Rocky open woodland and granite barrens along the Frontenac Neck are primary breeding habitat.
- Golden-winged Warbler (Vermivora chrysoptera): Threatened. Breeding populations documented within the Biosphere; sensitive to edge effects of linear clearings.
- Wood Thrush (Hylocichla mustelina): Threatened. Interior forest conditions required; fragmentation increases brood parasitism.

Flora

- Juniper Sedge (Carex juniperorum): Globally rare and Endangered. The Salmon River Alvar within the Biosphere hosts what may be the world's largest population.
- Lakeside Daisy (Hymenoxys herbacea) and Small White Lady's Slipper (Cypripedium candidum): Nationally rare plants on alvar and limestone habitats of the Napanee Plain section.

Aquatic Species

- Brook Floater (Alasmidonta varicosa): Endangered. Sensitive to turbidity, chloride loading, and altered thermal regimes. Dependent on karst spring discharge in the Napanee system.
- Lake Sturgeon (Acipenser fulvescens): Threatened. Present in the Bay of Quinte and lower watershed systems draining the Biosphere.

2. The Algonquin-to-Adirondacks Corridor and the Frontenac Neck

The Frontenac Arch is the ecological heart of the Algonquin-to-Adirondacks (A2A) corridor, a continental linkage of approximately 400 kilometres from Algonquin Provincial Park to Adirondack Park in New York State. The A2A Collaborative, with over 50 partner organizations, describes the corridor as 'one of the last remaining large-scale, intact forest and wetland linkages in eastern North America.'

The A2A corridor narrows dramatically as it descends from the broad Shield plateau toward the St. Lawrence River. NCC's Program Director for Eastern Ontario has identified the area between Kingston, Brockville, and Westport as 'the connection point, the narrow pinch point in that entire corridor.' The Cataraqui Trail's Frontenac Neck section (km 42–68.5) runs along the axis of exactly this pinch-point. The trail's own documentation explicitly names the feature: 'From Chaffey's Lock to Eel Bay on Sydenham Lake, the trail traverses a neck of the Canadian Shield known as the Frontenac Axis.' This is not coincidental language, it is the trail authority confirming that the Cataraqui Trail's midsection runs along the structural spine of the A2A corridor bottleneck.

The A2A Collaborative's research documents over 20,000 animals killed on roads within the region annually. Scientists have spent years collecting roadkill data to identify movement hotspots and wildlife mortality concentrations. An HSR corridor on the Cataraqui Trail alignment would introduce a sealed, fenced barrier directly through the movement bottleneck where that mortality is already concentrated, and would do so at the one location in the Frontenac Arch where no alternative movement path exists.

CRITICAL DISTINCTION: The Frontenac Neck as the A2A Bottleneck — Applicable to Any Crossing

The Frontenac Neck does not represent one possible path through the A2A corridor: it is the corridor at its most constricted point. This assessment uses the Cataraqui Trail as the reference alignment for the southern corridor because it is the most precisely documented corridor through this terrain — but the bottleneck is geographic, not corridor-specific. Any southern alignment crossing the Frontenac Neck — whether the Cataraqui Trail, a hydro transmission corridor, or another route — must pass through the same narrow strip of Shield between Chaffeys Lock and Eel Bay. Sydenham Lake, Opinicon Lake, and the Rideau Canal eliminate all alternative geometries. An HSR corridor through this terrain — regardless of its precise alignment — would simultaneously sever the A2A bottleneck where no bypass exists and introduce an impermeable barrier at the one location where wildlife movement between Algonquin and the Adirondacks must concentrate. The northern corridor, by contrast, crosses the Biosphere at greater width and in terrain where some dispersal capacity around the barrier ends may remain for highly mobile species.

3. Impact Assessment: northern corridor

The northern corridor follows a broadly direct alignment between Ottawa and Peterborough through Lanark, Frontenac, and Hastings Counties, traversing approximately 85 km of intact Precambrian Shield terrain within and adjacent to the Biosphere. While the northern corridor does not cross the Frontenac Neck bottleneck, it severs the A2A corridor across its broader width and threatens a range of upland wetland complexes, protected natural heritage features, and SARA-listed species.

3.1 Wildlife Corridor Fragmentation

The northern corridor's east-west alignment creates a fenced barrier approximately 60 metres wide running perpendicular to north-south A2A wildlife movement through the Shield. For wide-ranging species, Black Bear, Eastern Wolf, Fisher, Moose, this barrier fragments movement between northern Shield lakes and the southern portions of the Arch. The barrier crosses the Biosphere at greater width than the Frontenac Neck, meaning some residual dispersal capacity around the barrier ends may persist for highly mobile species over long time horizons, a meaningful distinction from any route through the sourther corridor Arch geometry.

3.2 Habitat Loss in the Shield Interior

The northern corridor crosses terrain with 85.6% forest cover, 98.4% riparian vegetation, and 38.6% interior forest, all substantially exceeding Environment Canada benchmarks. Construction requires cut-and-fill across wetland complexes, blasting through granite ridges with extensive spoil disposal, new access roads penetrating roadless terrain, and staging areas requiring clearing beyond the permanent footprint.

3.3 Protected Natural Heritage Features

- Hungry Lake Barrens (4,953 ha): Possibly the largest undisturbed granite rock barrens in southern Ontario.
- Puzzle Lake ANSI (2,138 ha): Highest documented number of provincially rare species of any ANSI in eastern or southern Ontario, including Toothcup (Rotala ramosior) — present at only two lakes in Lennox & Addington County.
- Kennebec Wetland Complex: Vast interconnected wetlands providing flood attenuation and drought moderation for downstream agricultural and municipal communities.
- Westplain Mud Lake ANSI and Harlowe Bog: Large peat and fen systems with uncommon wetland plant communities.

3.4 Species at Risk — northern corridor Specific

- Toothcup (Rotala ramosior): Endangered; found at only two lakes in Lennox & Addington County, potentially within the northern corridor's influence zone.
- Juniper Sedge: Endangered; the Salmon River Alvar hosts the world's largest known population.
- Blanding's Turtle.
- Eastern Whip-poor-will and Cerulean Warbler: Primary breeding habitats (Shield rock barrens and interior forest) directly affected.

4. Impact Assessment: southern corridor (Frontenac Neck Crossing — Cataraqui Trail Reference Alignment)

This section assesses the southern corridor using the former CN Railway alignment occupied by the Cataraqui Trail, 104 km from Smiths Falls to Strathcona near Napanee, as the reference corridor. This reference alignment is used because it is the most precisely documented existing corridor through the affected terrain. The ecological impacts described in this section are not exclusive to the Cataraqui Trail alignment: any route crossing the Frontenac Neck, including hydro transmission corridors and other alignments identified in the same geographic zone, would encounter the same A2A bottleneck geometry, the same SARA-listed species distributions, and the same constraint that no functional bypass exists through this section of the Shield. Route geometry may vary; the bottleneck does not. Biosphere-relevant impacts concentrate in two zones: the Frontenac Neck Shield section (km 42–68.5, approximately 26.5 km) and the Napanee Plain karst section (km 68.5–103, approximately 34.5 km).

4.1 Zone 1: Limestone and Sandstone Farmland (km 0–42, Smiths Falls to Chaffeys Lock)

The trail's western section passes through flat farmland and mixed woodland on limestone and sandstone between Smiths Falls and Chaffeys Lock. Key impacts in this zone are primarily heritage and jurisdictional:

- Rideau Canal trestle (Chaffeys Lock, km 42): The trail crosses the Rideau Canal on a 1912 heritage railway bridge. This is a federally recognized heritage structure within the Rideau Canal UNESCO World Heritage Site corridor. HSR operating loads at 300 km/h would require replacement or fundamental reconstruction of this structure. Any modification must satisfy Parks Canada's obligations under the Canada National Parks Act, the Heritage Railway Stations Protection Act, and potentially the UNESCO World Heritage Committee if Outstanding Universal Value is affected.
- Trans Canada Trail: The 78.2 km section of the Cataraqui Trail from Smiths Falls to Harrowsmith is part of the Trans Canada Trail. Conversion to HSR would permanently eliminate this designation and the multi-use corridor function it represents across Leeds and Grenville, Frontenac, and Lennox & Addington Counties.
- Charleston Lake KBA landscape: The western section passes through terrain connecting to the Charleston Lake KBA. Construction-phase access and vegetation clearing would affect connectivity to this nationally significant area.

4.2 Zone 2: The Frontenac Neck (km 42–68.5, Chaffeys Lock to Eel Bay/Sydenham Lake)

This is the most ecologically critical section of the entire assessment. The trail's Frontenac Neck section traverses 26.5 km of rugged Canadian Shield, rocky ridges and outcrops of pink granite and grey gneiss, plentiful lakes and swamps, and a density of wetlands that field observers describe as extraordinary. Cell phone service is 'unreliable or non-existent' through this section, a practical indicator of its remoteness and intactness. No settlements of significance exist between Chaffeys Lock and Perth Road Village.

4.2.1 A2A Corridor Severance at the Bottleneck

An HSR corridor through the Frontenac Neck would introduce a sealed, fenced barrier through the geographic bottleneck of the A2A system within the Biosphere. Unlike the northern corridor, where the Arch is broad enough that some dispersal capacity may persist for highly mobile species, the Frontenac Neck is structurally constrained. Sydenham Lake to the south, the Rideau Canal system to the north, and granite ridges to the east and west create a landscape where wildlife movement is already channelled through a narrow strip of Shield terrain. The HSR right-of-way would seal this channel

entirely, with no functional bypass available for any species requiring north-south movement through the Arch.

This is the precise area that FABN's Ecological Corridors Project has identified as the priority focus: the Charleston Lake to Thousand Islands linkage. FABN's participatory mapping workshop confirmed the presence of threatened and culturally significant species throughout the Frontenac Neck terrain. The Frontenac Neck section of the Cataraqui Trail is not peripheral to the Biosphere's connectivity function, it is its axis.

4.2.2 Wetland and Aquatic System Impacts

The Frontenac Neck contains extraordinary wetland density for a former railbed corridor. Field observers report multiple ponds, open-water cattail marshes, and small lakes within every few kilometres of trail. An HSR construction programme would require:

- Reconstruction of all drainage structures to HSR load and geometry specifications, existing culverts and open-bottom crossings designed for historic railway loads would require replacement, altering hydrological connectivity between wetlands on either side of the embankment;
- Raising the track bed to HSR standards across a graded former railbed whose current profile intersects wetland water tables, with effects on the hydrological regime of adjacent wetlands extending well beyond the physical footprint;
- Vegetation clearing for a minimum 60-metre fenced right-of-way consuming wetland edge habitat that currently provides the ecological connectivity value of this section;
- Overhead catenary installation and stray-current earthing systems introducing electrical hazards to aquatic ecosystems in immediate proximity to the track.

4.2.3 SARA Critical Habitat — Specific Exposure

Gray Ratsnake (Frontenac Axis population) critical habitat is designated and mapped throughout the Frontenac Neck section. The microhabitat features of the former railbed, warm rock cuts, embankment edges, hedgerow-forest transitions, open rocky terraces, are precisely the features protected by the SARA habitat regulation: thermoregulation sites, egg-laying substrates, and communal basking and shedding locations, each with protected buffers of 30–1,000 metres. SARA s. 58 prohibits destruction of this critical habitat without a valid s. 73 permit. No such permit has been applied for and no critical habitat mapping at corridor resolution has been published by ALTO HSR.

Blanding's Turtle faces acute construction-phase risk. The wetland density of the Frontenac Neck means that HSR construction activity would intersect Blanding's Turtle movement corridors at multiple points across the entire 26.5 km Frontenac Neck section. Multi-year construction activity through active Blanding's Turtle habitat is functionally unavoidable, and even low rates of additional adult mortality can collapse local populations given this species' slow reproductive rate.

4.3 Zone 3: Napanee Plain (km 68.5–103, Eel Bay to Strathcona near Napanee)

From Eel Bay on Sydenham Lake, the trail descends onto the flat limestone plain of the Napanee watershed, passing through Harrowsmith, Yarker, Camden East, and Newburgh before terminating at Strathcona near Napanee. This zone presents a qualitatively distinct but still severe set of ecological and public safety concerns.

4.3.1 Napanee Karst Aquifer and Drinking Water Risk

The Cataraqui Trail's Napanee Plain section crosses active karst limestone terrain, Ordovician formations containing dissolution features including sinkholes, losing streams, cave conduit systems, and karst springs. These springs sustain the baseflow of the Napanee River and supply municipal drinking water for Napanee and wellfield water for Stone Mills and surrounding rural communities. HSR infrastructure on karst terrain poses specific, severe risks:

- Dynamic loads from 300 km/h train passages can induce progressive sinkhole collapse within the embankment footprint and in the broader zone of karst conduit influence, a risk that cannot be fully characterized without site-specific hydrogeological investigation;
- De-icing chemicals, particularly chloride-based products, enter karst groundwater through sinkholes and losing streams without attenuation, reaching springs and the municipal supply system within hours to days of application. Standard stormwater management systems designed for surface or fractured-rock settings are ineffective in karst;
- Embankment construction can intercept subsurface karst drainage pathways, permanently altering spring discharge patterns and the cold-water conditions that sustain Brook Floater habitat in the Napanee River.

4.3.2 Napanee Limestone Plain Ecological Features

The Napanee Plain section crosses alvar ecosystems, globally rare open limestone plain habitats supporting Lakeside Daisy, Small White Lady's Slipper, and the alvar plant communities associated with the proposed Napanee Limestone Plain KBA. These alvar systems are dependent on precise hydrological conditions maintained by karst drainage. Infrastructure altering drainage or introducing de-icing salt loading degrades alvar vegetation rapidly, as alvar species are adapted to calcium-rich but low-nutrient, low-chloride conditions.

- Gray Ratsnake critical habitat extends into the Napanee Plain section; warm limestone alvar and edge habitats in this zone are actively used by the Frontenac Axis population.
- Brook Floater: Endangered. Chloride loading from de-icers is a documented threat mechanism. The Napanee Plain HSR section would introduce this risk directly into spring-fed tributaries sustaining Brook Floater habitat in the Napanee River.
- Wood Turtle: Endangered. Present in Salmon River and Napanee tributary systems crossed by this section.

4.4 Loss of Trans Canada Trail and Corridor Function

The Cataraqui Trail is not merely a recreational amenity. Its 78.2 km Trans Canada Trail designation between Smiths Falls and Harrowsmith reflects national significance as a multi-use corridor. Its ecological function, as a low-disturbance linear habitat corridor permeable to wildlife moving north and south through the Arch, is equally significant and currently operational. The former CN Railway right-of-way has undergone ecological recovery since decommissioning: hedgerows have established, wetland margins have encroached on ballast, and the absence of high-speed motorized traffic has allowed the corridor to function as a wildlife pathway.

Conversion to a fenced, electrified, 300 km/h HSR corridor would permanently and irreversibly eliminate both the recreational and ecological corridor functions of the trail. No mitigation measure can restore the Trans Canada Trail function once the corridor is sealed. The loss is absolute, immediate upon construction, and permanent for the operational life of the railway.

4.5 Community Impact Without Community Benefit

A distinctive and legally significant feature of the Cataraqui Trail alignment is the profile of communities along its length. The trail passes through or near: Portland, Chaffeys Lock, Perth Road Village, Sydenham, Harrowsmith, Yarker, Camden East, Newburgh, and Strathcona. None of these communities is of a scale to warrant or support an HSR station, and none appears in ALTO's station planning documents. These communities would absorb the full burden of construction impact, noise, vibration, dust, access road traffic, land expropriation, permanent fencing across local trails and farm laneways, loss of snowmobile corridor access, without receiving any transit-oriented development benefit, reduced travel time, or economic uplift in return.

The construction phase introduces two further fiscal impacts that fall entirely on local municipalities. First, HSR construction generates years of heavy aggregate, concrete, and steel trucking on county

and township roads designed for agricultural traffic. Evidence from the UK's HS2 project, the most comparable recent construction programme, documented roads in rural counties described in Parliament as "completely destroyed" by construction vehicles; compensation paid to one county amounted to barely enough to resurface five metres of road. Eastern Ontario's township roads are subject to spring weight restrictions precisely because their base structures cannot withstand sustained heavy haulage, making the damage risk here greater than the HS2 context, not lesser. Road repair costs fall on municipal budgets regardless of whether adequate compensation from the project is ultimately negotiated.

Second, every hectare of land expropriated for the HSR right-of-way is transferred to a federal Crown corporation and becomes constitutionally exempt from municipal property taxation. Payments in lieu of taxes are discretionary, not guaranteed, and are frequently assessed below the rate the land would generate as taxable private property. For smaller townships along this corridor, where residential and farm properties generate the entirety of the local tax base, permanent removal of land from the assessment roll reduces tax revenue while the demand for municipal services remains constant or increases. The remaining ratepayers absorb the shortfall through higher property tax rates. This mechanism means that households and farms that are not directly expropriated nevertheless face higher property taxes to compensate for the fiscal gap left by the project. International research on HSR in non-station rural municipalities consistently documents this pattern: the benefits of the project flow to passengers and station cities, while the costs, road damage, tax base erosion, construction disruption, and property value blight from the moment the corridor is announced, are borne locally.

This disproportionate impact pattern is intensified here by the complete absence of any compensating benefit, and by the permanent loss of the Cataraqui Trail as a locally valued community, tourism, and ecological corridor resource.

5. Comparative Impact Analysis: Frontenac Arch

The following matrix compares the anticipate effects of routes through the two ALTO Corridors on the Frontenac Arch.

Impact Category	northern corridor	southern corridor
Biosphere crossing length	~85 km (broad Shield interior, Lanark–Hastings)	~61 km total: 26.5 km Frontenac Neck Shield + 34.5 km Napanee Plain karst
A2A corridor impact	Severs broad Shield connectivity zone; some dispersal potential may persist at barrier ends for highly mobile species	Severs the Frontenac Neck — the A2A bottleneck — where no bypass geometry exists; absolute continental severance
Corridor width at crossing point	Shield at greater width; flanking terrain allows potential long-range dispersal around barrier	Constrained by Sydenham Lake, Opinicon Lake, and Rideau Canal; no effective bypass available for any species
Existing ecological asset destroyed	Greenfield Shield terrain; no prior corridor function	Destroys functioning permeable movement corridor (former CN railbed) and 78.2 km of Trans Canada Trail

Impact Category	northern corridor	southern corridor
Primary habitat threatened	Intact Shield forest, upland wetlands, rock barrens	Frontenac Neck lakes and wetlands (A2A bottleneck) + Napanee Plain karst and alvar systems
KBA linkage	Frontenac Forests KBA (upper watershed headwaters)	Cataraqui Trail Frontenac Neck is the linkage zone between Frontenac Forests KBA and Thousand Islands KBA; Napanee Plain section approaches proposed 4th KBA
SARA critical habitat	Blanding's Turtle (Shield uplands); Toothcup lakes.	Gray Ratsnake critical habitat throughout entire Frontenac Neck section; Blanding's Turtle (wetland network); Wood Turtle (Napanee tributaries)
Wetland impact	Kennebec Complex and Shield bog/fen systems	Multiple lake and wetland crossings in Frontenac Neck; alvar hydrological disruption on Napanee Plain
Groundwater risk	Fracture-flow alteration; kame moraine recharge disruption	Karst sinkhole induction; de-icing chemicals reach municipal water supply within hours; no attenuation in karst conduits
Heritage infrastructure	No confirmed heritage structure conflict identified at this stage; northern corridor study zone includes communities and infrastructure adjacent to the Rideau Canal UNESCO World Heritage Site — detailed heritage survey required	1912 CN trestle at Chaffeys Lock: federal heritage structure within Rideau Canal UNESCO World Heritage corridor
Trans Canada Trail	Crosses but does not follow or consume any Trans Canada Trail-designated corridor,	Permanently destroys 78.2 km of Trans Canada Trail (Smiths Falls to Harrowsmith) — irreversible
De-icing chemical risk	Moderate: porous granular media provides attenuation	Severe on Napanee Plain: karst conduits transmit contamination directly to springs and municipal water supply within hours
Community benefit	No HSR station planned	No HSR station planned
UNESCO MAB compatibility	Route crosses Frontenac Arch at broad width in an area not included in the UNESCO Biosphere Reserve designation; degradation of conservation function serious but geographically distributed	Route passes through Biosphere Reserve's core connectivity spine; degradation of conservation function potentially incompatible with MAB obligations

6. Regulatory and Policy Framework

6.1 UNESCO Man and the Biosphere Programme Obligations

Canada's designation of the Frontenac Arch as a UNESCO Biosphere Reserve carries international obligations under the MAB Programme. The Lima Action Plan (2016) establishes expectations that governments avoid activities undermining Biosphere core functions. The Cataraqui Trail alignment does not skirt the Biosphere's edge: its Frontenac Neck section runs through the core connectivity zone. The MAB framework is explicit that core and buffer zones require the highest level of protection from incompatible development. A federal infrastructure project that seals the central axis of a UNESCO Biosphere Reserve's wildlife corridor function cannot be reconciled with Canada's ongoing MAB commitments without at minimum a formal MAB compatibility review.

6.2 Species at Risk Act (SARA)

- Section 58: Gray Ratsnake (Frontenac Axis population) SARA critical habitat is designated and mapped throughout the Frontenac Neck. The habitat regulation protects all occurrence sites, hibernacula within 150 metres, egg-laying and basking sites within 30 metres, and all suitable habitat within 1,000 metres. Every kilometre of the km 42–68.5 section passes through or near mapped critical habitat. Any construction destroying this habitat without a valid s. 73 permit constitutes a federal offence regardless of the proponent's status as a Crown corporation.
- Section 32: Construction through the Frontenac Neck would result in foreseeable mortality for Blanding's Turtle and Gray Ratsnake during multi-year construction activity. These deaths are not incidental risks, both species are documented throughout this section, and construction cannot avoid individual mortality. Section 32 prohibits killing, harming, or harassing listed species without authorization.
- Sections 77–79: The formal environmental assessment under the Impact Assessment Act must address effects on all SARA-listed species and critical habitat. No ALTO consultation document has performed this analysis at corridor resolution. This is not a documentation gap, it is the absence of the legally required analytical foundation for corridor selection.

6.3 Rideau Canal UNESCO World Heritage Site

The Rideau Canal is both a Canadian Heritage Waterway and a UNESCO World Heritage Site administered by Parks Canada. The Cataraqui Trail crosses the Canal on the 1912 CN heritage trestle at Chaffeys Lock (km 42). Any modification to this crossing for HSR loads and geometry requires Parks Canada approval under the Canada National Parks Act, heritage assessment under the Heritage Railway Stations Protection Act, and may trigger review by the UNESCO World Heritage Committee if the modification affects the site's Outstanding Universal Value. These obligations are independent of and additional to the environmental assessment under the Impact Assessment Act. ALTO HSR has not addressed these requirements in any public consultation document.

6.4 Trans Canada Trail — Federal Program Obligations

The Trans Canada Trail carries federal support through the Trans Canada Trail Foundation and associated federal grants. The Smiths Falls to Harrowsmith section of the Cataraqui Trail (78.2 km) carries Trans Canada Trail designation. Conversion of this section to HSR infrastructure would permanently extinguish 78.2 km of Trans Canada Trail with no identified replacement corridor. The federal government's financial and programmatic investment in the Trans Canada Trail creates at minimum a policy contradiction — and potentially a legal obligation to demonstrate that no alternative

corridor exists before an HSR alignment is authorized that would permanently destroy a nationally designated trail.

6.5 Cataraqui Conservation Ownership

The majority of the Cataraqui Trail is owned by Cataraqui Conservation. Acquisition of the right-of-way for HSR purposes would require expropriation from a conservation authority — a body whose statutory mandate is explicitly to protect and manage natural heritage lands. This expropriation would engage the Conservation Authorities Act, the Impact Assessment Act, and any conditions attached to original conservation authority land grants. Cataraqui Conservation's regulated areas along the trail include wetland and watercourse regulation zones requiring permits for any development activity in or near regulated features.

6.6 Fisheries Act

The Frontenac Neck section contains numerous lake and stream crossings where construction would generate turbidity, thermal alteration, and altered flow regimes. The presence of SARA-listed Brook Floater in the downstream Napanee system and of Brook Trout in Frontenac Neck headwater streams triggers Fisheries Act s. 35 requirements for authorization of any harmful alteration, disruption, or destruction of fish habitat.

7. Cumulative and Indirect Effects

7.1 Infrastructure Barrier Stacking in the A2A Corridor

The Frontenac Arch is already crossed by Highway 401 and Highway 7 (both east-west) and multiple county roads. The A2A Collaborative's research confirms that existing roads already impose significant wildlife mortality through the Arch, and that no point in southern Ontario is more than 1.5 km from a road. Adding a fully fenced HSR barrier through the Frontenac Neck compounds existing fragmentation at the exact location where cumulative barrier effects are already most acute. Population viability analysis for Gray Ratsnake and Blanding's Turtle shows that small absolute increases in adult mortality through the corridor can collapse local populations. The cumulative effect of the existing road network plus a Cataraqui Trail HSR barrier on population persistence in the Frontenac Neck has not been modelled or published.

7.2 Climate Change and Northward Range Shifts

Climate projections require substantial northward range shifts for eastern North American species over coming decades. The Frontenac Neck is the primary geographic structure through which this movement must pass within the Biosphere. An infrastructure project that permanently seals this corridor during the critical period of climate-driven range shifts would block the adaptive capacity of hundreds of species to track suitable climate space, with consequences extending from Algonquin to the Adirondacks.

7.3 Secondary Impacts of Trail Loss

Loss of the Cataraqui Trail as a low-disturbance corridor would displace recreational users, hikers, cyclists, equestrians, snowmobilers, to alternative access routes in the broader Shield landscape, increasing pressure on Frontenac Provincial Park, QUBS properties, and NCC conservation lands. Snowmobile use currently concentrated on the groomed trail corridor would also displace to informal routes. These secondary effects would compound the direct ecological impact of the HSR corridor.

7.4 Induced Development on the Napanee Plain

The Cataraqui Trail's Napanee Plain section terminates near Strathcona north of Napanee. An HSR through-corridor at this location could generate induced commercial and residential development in the agricultural and karst landscape of the Napanee Plain — terrain whose ecological significance rests

precisely on its low development density and intact karst hydrology. Secondary development pressure is a cumulative risk not addressed in any ALTO assessment document.

8. Critical Information Gaps

The following substantive gaps in environmental baseline information and assessment framework are identified. These are not procedural matters: they represent the foundational information without which impact assessment cannot be legally or scientifically complete.

- No SARA critical habitat mapping for Gray Ratsnake (Frontenac Axis population), Blanding's Turtle, or Wood Turtle has been incorporated into publicly available corridor assessment materials at the resolution required by SARA ss. 77–79 and the Impact Assessment Act. For the southern corridor, this gap is particularly acute: every kilometre of the Frontenac Neck section falls within or near designated critical habitat.
- No population viability analysis for Gray Ratsnake or Blanding's Turtle has been published modelling the cumulative effect of the Cataraqui Trail Frontenac Neck HSR barrier added to the existing road matrix. This analysis is essential before corridor selection.
- No assessment of the Cataraqui Trail's current ecological corridor function has been conducted. The trail is treated in consultation materials as a recreational facility, not as a functioning wildlife movement corridor. This framing is ecologically incorrect and legally consequential.
- No wildlife connectivity modelling has been published comparing the relative permeability of both corridors to A2A corridor movement, specifically addressing the Frontenac Neck bottleneck geometry of the Cataraqui Trail alignment versus the northern corridor’s broader but equally damaging Shield crossing.
- No Parks Canada or UNESCO World Heritage impact assessment has been published for the Chaffeys Lock trestle crossing, including analysis of alternatives and the consequences for the Rideau Canal World Heritage Site's Outstanding Universal Value.
- No Trans Canada Trail impact assessment has been published addressing the permanent loss of 78.2 km of Trans Canada Trail designation, including analysis of whether any alternative corridor exists and the feasibility of replacement.
- No UNESCO MAB compatibility assessment has been published for either corridor. The Cataraqui Trail alignment requires the most urgent version of this assessment, given that it proposes to seal the Biosphere's core connectivity spine.
- No karst hydrogeological assessment of the Napanee Plain section has been published, including dye-trace testing to establish the relationship between the trail corridor and municipal water supply springs in Napanee and Stone Mills.
- No assessment of the feasibility of wildlife crossing structures through the Frontenac Neck sufficient to restore A2A corridor permeability has been published. Given the structural constraints of the Frontenac Neck geometry, this feasibility demonstration is a prerequisite for any lawful consideration of the Cataraqui Trail alignment.

9. Recommendations

9.1 Pre-Decision Requirements

1. Commission an independent wildlife connectivity assessment for both corridors using species-level corridor modelling for Gray Ratsnake, Blanding's Turtle, Cerulean Warbler, Eastern Whip-poor-will, and large mammals. This modelling must explicitly address the Frontenac Neck bottleneck geometry of the Cataraqui Trail alignment and compare it to the northern corridor's broader Shield crossing.
2. Publish SARA critical habitat mapping for all listed species at corridor resolution for both corridors, with legal analysis of s. 32 and s. 58 implications. This analysis must be completed before, not after, corridor selection.
3. Conduct a formal UNESCO MAB compatibility assessment and transmit findings to the Canadian National Commission for UNESCO and the International MAB Secretariat before any corridor selection decision.
4. Commission a formal Parks Canada and UNESCO World Heritage impact assessment of the Cataraqui Trail alignment's crossing of the Rideau Canal at Chaffeys Lock, including analysis of alternatives to the 1912 heritage trestle.
5. Publish a Trans Canada Trail impact assessment addressing the permanent loss of 78.2 km of Trans Canada Trail on the Cataraqui Trail alignment, including analysis of alternative corridor options and the feasibility of replacement.
6. Commission independent karst hydrogeological mapping of the Cataraqui Trail's Napanee Plain section, including dye-trace testing establishing flow connectivity between the corridor and municipal water supply springs.
7. Conduct population viability analysis for Gray Ratsnake (Frontenac Axis population) and Blanding's Turtle modelling cumulative mortality under the Cataraqui Trail Frontenac Neck crossing added to the existing road barrier matrix.
8. Engage Cataraqui Conservation, the Friends of the Cataraqui Trail, the Frontenac Arch Biosphere Network, the A2A Collaborative, the Nature Conservancy of Canada, the Rideau Waterway Land Trust, Parks Canada, and the Mohawks of the Bay of Quinte as technical partners in the formal environmental assessment process.

9.2 If a route through the northern corridor Is selected

- Require wildlife overpass structures at minimum intervals of 500 metres across the full fenced right-of-way, designed for Blanding's Turtle, and large mammals, with drift fencing to guide use.
- Mandate bridge-only crossings of all wetland complexes including the Kennebec system; prohibit embankment fill across wetlands.
- Require controlled blasting protocols with continuous vibration monitoring at all protected wetlands and ANSI features within 1 km of the alignment.
- Establish an A2A Corridor Restoration Fund, capitalized before construction, to support net-positive habitat outcomes across the Biosphere.

9.3 If a route through the southern corridor Is selected

- Demonstrate, before construction authorization is granted, the feasibility of wildlife crossing structures capable of restoring A2A corridor connectivity through the Frontenac Neck. If feasibility cannot be demonstrated, the alignment must be rejected on grounds that SARA critical habitat protection and UNESCO MAB obligations cannot be met.
- Require all construction through the Frontenac Neck (km 42–68.5) to be bridge-over or elevated structure where crossing or flanking regulated wetlands and lake margins; prohibit embankment fill in regulated areas.
- Prohibit any construction within SARA-designated critical habitat without a valid s. 73 permit and binding net-positive critical habitat outcome agreement with affected species recovery teams.
- Require wildlife overpass structures at minimum intervals of 500 metres across the full fenced right-of-way, designed for Gray Ratsnake, Blanding's Turtle, and large mammals, with drift fencing to guide use.
- Require pre-construction hibernacula surveys for Gray Ratsnake within a 1,500-metre corridor buffer and binding avoidance of all hibernacula and 150-metre buffers.
- Provide binding replacement for the full 78.2 km of Trans Canada Trail lost on the Cataraqui Trail alignment on an identified alternative corridor with equivalent multi-use capability, before HSR construction begins.
- Require full replacement or heritage-compliant modification of the Chaffeys Lock trestle in consultation with Parks Canada, subject to Heritage Railway Stations Protection Act assessment and UNESCO World Heritage review.
- Prohibit chloride-based de-icers throughout the Napanee Plain karst section; require real-time groundwater monitoring with automatic operational shutdown protocols if chloride exceeds established thresholds at monitored springs.

10. Conclusions

This assessment uses the Cataraqui Trail, the former CN Railway corridor from Smiths Falls to Strathcona near Napanee, as the reference alignment for the southern corridor. This choice reflects the precision of available documentation for that corridor. The conclusion, however, is geographic: any southern corridor alignment crossing the Frontenac Neck would encounter the same A2A bottleneck constraint.

The Cataraqui Trail does not avoid the Biosphere’s sensitive interior; its Frontenac Neck section (km 42–68.5) runs along the spine of the Algonquin-to-Adirondacks corridor at its most geographically constricted point. Alternative southern alignments, including those following hydro transmission corridors or other routes through the same region, are constrained by the same terrain: Sydenham Lake, Opinicon Lake, and the Rideau Canal funnel all practicable crossings into the same narrow strip of Shield. The trail’s own documentation names this section the ‘Frontenac Neck’ and explicitly describes it as the connection between the vast northern Shield and its Adirondack southern extremity. The bottleneck is not a property of the Cataraqui Trail alignment; it is a property of the landscape itself.

Both ALTO study corridors cross a portion of the Frontenac Arch, but at different locations and with fundamentally different connectivity consequences. The northern corridor crosses the Arch at greater width, where some residual dispersal capacity may persist for highly mobile species around the barrier ends. The southern corridor crosses the Arch at its narrowest point, where the Frontenac Neck's geometry makes bypass movement impossible and corridor severance absolute. The southern corridor additionally converts an existing, functioning, nationally designated ecological corridor into one of the

most impermeable barriers in the Frontenac Arch's history; destroys 78.2 km of Trans Canada Trail permanently; and requires major intervention in the Rideau Canal UNESCO World Heritage Site at Chaffeys Lock. Its Napanee Plain section introduces karst contamination risk to municipal drinking water with no viable technical remedy under normal infrastructure operations.

The environmental information currently available from ALTO HSR is insufficient to support a lawful route selection decision under the Impact Assessment Act, or to determine that either corridor is compatible with SARA obligations for species at risk. The possible southern corridor route alignment requires urgent and comprehensive environmental baseline work. This Initiative urges ALTO, Transport Canada, and the Impact Assessment Agency of Canada to require the complete baseline assessments identified in Section 9 before any corridor selection decision is finalized, and provide a level of scrutiny appropriate for a proposal to build permanent industrial infrastructure through the axis of a UNESCO Biosphere Reserve's core wildlife corridor — which is precisely what it is.

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This assessment has been prepared independently of ALTO HSR and Transport Canada using publicly available data with human review. It is submitted as part of the public consultation process. All sources are documented.

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