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Nickel Mining in Ontario, Canada

An overview of socioenvironmental governance in the sector

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Nickel Mining in Ontario, Canada: An overview of socioenvironmental governance in the sector

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1.0 Introduction

This case study is part of a broader project focused on strengthening supply chain resilience through analysis of the environmental and associated social impacts of critical minerals using case studies of nickel, lithium, and copper. As the second in a series and one of two on nickel, this case study describes environmental and associated social issues from nickel mining and processing in Ontario, Canada, and examines policy measures for managing them. The conclusions and lessons learned from this case study can be used to guide sustainable nickel sulfide ore mining and processing in Canada, as well as other jurisdictions.

2.0 Methodology

The case study is primarily based on desk research, including peer-reviewed articles, news reports, laws and policy documents, and company reports. This research was conducted from May to September 2025. Supplementary insights were obtained through virtual interviews with industry associations and advisors on Indigenous rights in mining in September 2025.

3.0 Context

Comprehensive contextual information is provided in two related Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) publications: a country factsheet on Canada (IGF, 2026a) and a commodity profile on nickel (IGF, 2026b).

3.1 Geological and Mining Context

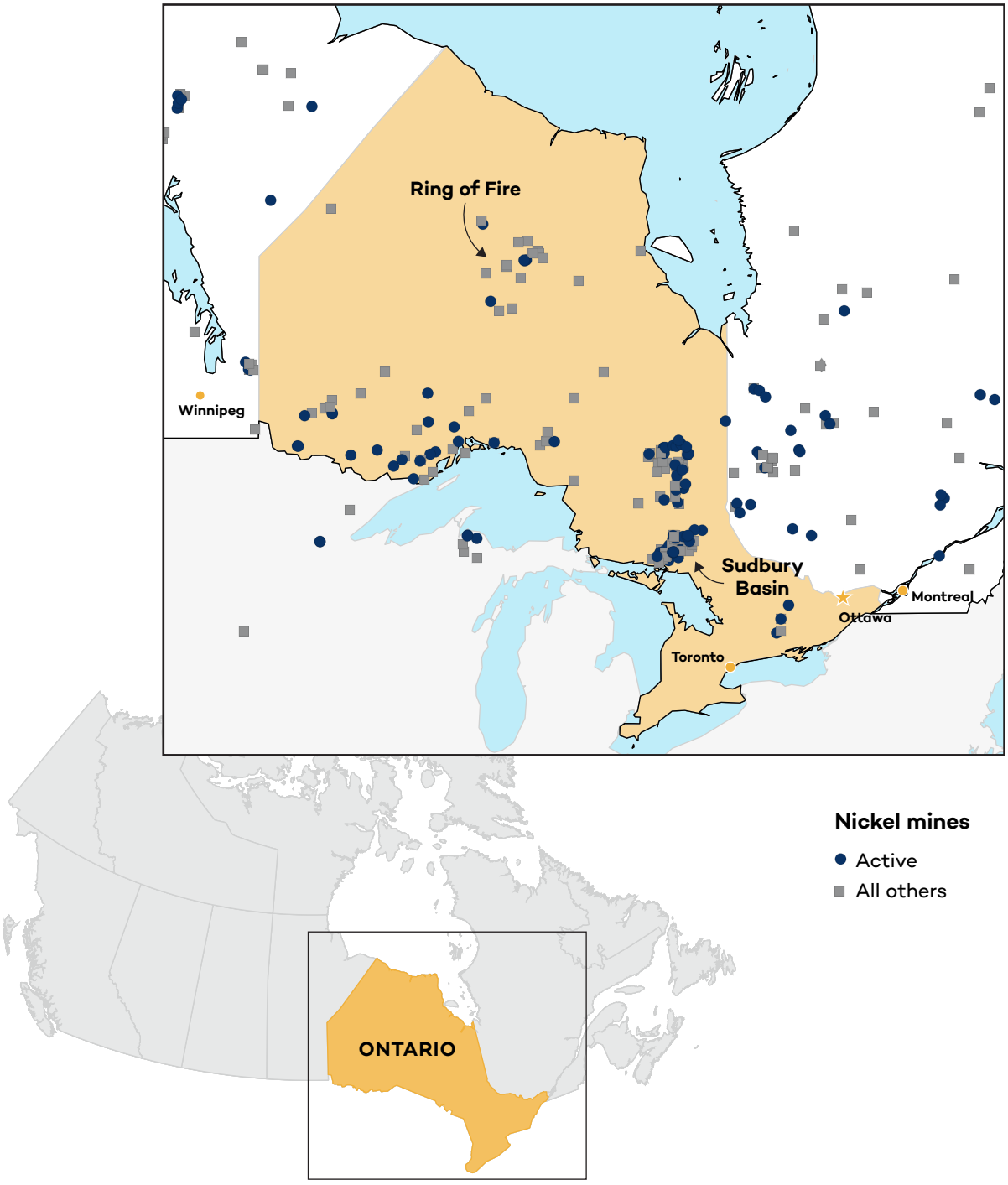
Canada holds the world's eighth-largest nickel reserves, estimated to be 2.2 million tonnes, or approximately 2% of global reserves (Natural Resources Canada, 2026). In 2024, Canada produced 125,364 tonnes of nickel, making it the fourth largest global producer (Natural Resources Canada, 2026). In Canada, mining legislation is primarily developed and administered at the provincial level, resulting in variation across provinces. This case study focuses on Ontario because, as illustrated in Table 1, it is Canada's largest provincial nickel producer, accounting for almost 40% of national nickel production (Natural Resources Canada, 2026). The Sudbury Basin and the Ring of Fire are two major clusters for nickel production (Ontario Ring of Fire, n.d.). Eight of Canada's 15 nickel mines and one of its three nickel refineries are located in Ontario. Produced nickel is refined at three major refineries in Fort Saskatchewan, Alberta; Sudbury, Ontario; and Long Harbour, Newfoundland and Labrador.

TABLE 1. Geographical distribution of Canadian nickel production by province in 2024

Province	**Nickel produced** (thousand tonnes)	**Percentage of total Canadian production**
Ontario	50	39.9%
Quebec	46.5	37.1%
Newfoundland and Labrador	17.2	13.7%
Manitoba	11.6	9.3%
Total	125.3	100%

Source: Adapted from Natural Resources Canada, 2026.

FIGURE 1. Map of nickel mines in Ontario



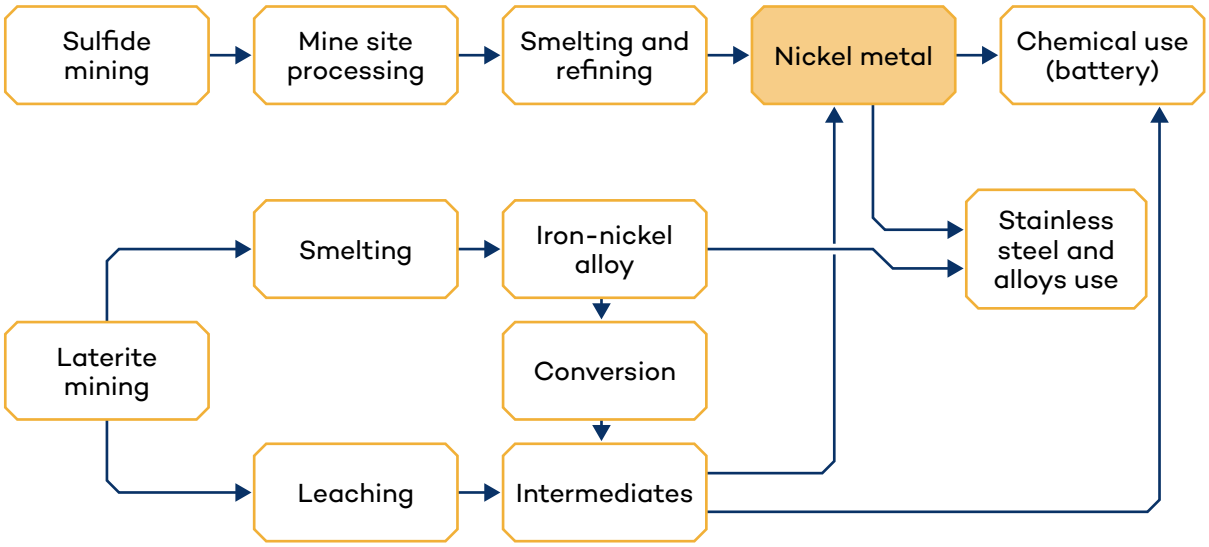
Source: Author.

Nickel sulfide ores can be found near the surface or deep underground and are generally found in temperate to sub-Arctic regions such as Canada, Russia, and Australia (Insidexploration, 2024). Sulfide ores usually have higher nickel grades than laterite ores and often contain other metals, such as cobalt, copper, platinum, and palladium which can be valorized as byproducts. Sulfide ores are usually concentrated using conventional mineral

processing techniques such as flotation[1] and gravity separation[2] before further processing. Due to this initial concentration stage, which is not applicable to laterite ores, sulfide ores have a higher processing efficiency and come with valuable co-products. This double advantage makes sulfide ores the preferred and more cost-effective source for producing high-purity Class 1 nickel.

Figure 2 illustrates the process flows from sulfide and laterite mining into stainless steel and battery production.

FIGURE 2. Flowchart of fresh nickel



Source: Nickel Institute, 2024.

3.2 Socio-Economic Profile

Ontario's mining sector employs about 150,000 people. Nickel mining is concentrated in northern regions where communities are more directly exposed to the environmental footprint of mining activities, including impacts on land and water resources.

According to figures from 2016, women comprise 13% of the mining workforce in Ontario (Ontario Mining Association, n.d.), slightly lower than the national average of 16%, though at the higher end of the global mining sector average of 5%–15% (IGF, 2022). By comparison, women account on average for 48% of the workforce across other industries in Canada (Mining Industry Human Resources Council, 2024).

Ontario is home to 22.5% of the Indigenous population in Canada, and they make up 2.9% of the province's inhabitants (Statistics Canada, 2021). The largest group of Indigenous Peoples are First Nations (61.7%), followed by Metis (33.1%), and Inuit (1.1%) (Statistics Canada, 2021). Many nickel mines, such as the Eagle's Nest Mine Project (Ring of Fire, Wyloo) or Crawford

[1] Flotation is a mineral processing method used to separate and concentrate the valuable part of ores by altering their surfaces to either repel or attract water (Woods, 1981).

[2] Gravity separation is used to separate different metals and minerals based on their gravity or density. This method sorts valuable heavy minerals from lighter, less valuable gangue (Sustainability Directory, n.d.).

Nickel Project (Canada Nickel, roughly 42 km north of Timmins), are located on or near Indigenous territories.

In 2023–2024, Indigenous Peoples represented 12% of Ontario's mining workforce, compared with 3% in the general provincial workforce (Statistics Canada, 2021). This relatively high participation in the mining sector is partly due to the location of many mining projects on or near Indigenous Peoples' lands (Pugliese, 2025).

First Nations in Northern Ontario have signed over 140 agreements with mining companies to secure employment opportunities and equity in projects (Ontario Mining Association, 2025). This has resulted in notable economic benefits: Indigenous communities in mining subregions of Northern Ontario now earn incomes 16% higher than those in non-mining subregions, and the income gap with the regional average narrowed nearly twice as fast between 2006 and 2020 (Organization for Economic Cooperation and Development [OECD], 2025). Despite this progress, Indigenous Peoples' incomes remain about 14% below the Northern Ontario general average (OECD, 2025).

3.3. Governance and Regulatory Framework

Developing a mine in Ontario requires obtaining key permits issued by both provincial and federal agencies, as depicted in Table 2.

TABLE 2. Key permits required for development of a mine in Ontario

Type of permit	Issuing agency	Regulation
Mining lease	Ministry of Energy and Mines (MEM)	Ontario Mining Act (R.S.O., 1990, July 14, 2025, update)
Production licence	MEM	Ontario Mining Act (R.S.O., 1990, July 14, 2025, update)
Environmental assessment approval	Ministry of Environment, Conservation and Parks	Ontario Environmental Assessment Act (R.S.O. 1990, c.E.18)
Impact assessment approval	Impact Assessment Agency of Canada	Canadian Impact Assessment Act, S.C. 2019, c. 28, s. 1
Licence to occupy Crown land	MEM	Ontario Mining Act (R.S.O., 1990)
Permit to take water (for more than 50,000 litres per day)	Ontario Ministry of Environment, Conservation and Parks	Ontario Water Resources Act, R.S.O. 1990, c. O.40 Ontario Regulation 387/04 (Water Taking and Transfer)
Highway Corridor Building/Land Use Permit	Ontario Ministry of Transportation	Public Transportation and Highway Improvement Act, R.S.O. 1990, c. P.50

Type of permit	Issuing agency	Regulation
Environmental compliance approval (multi-media)	Ministry of Natural Resources	Environmental Protection Act, R.S.O. 1990, Section 9 (air, noise, vibration), Section 27 (waste), Section 53 (sewage)
Explosives storage and safety permits	Ministry of Labour, Immigration, Training and Skills Development	Occupational Health and Safety Act and Regulation 854 (Mines and Mining Plants)
Explosives factory licence	Natural Resources Canada	Explosives Act, 2013 and Explosives Regulations, 2013 and Amendments
Explosives transportation	Transport Canada	Explosives Act, 2013 and Explosives Regulations, 2013 and Amendments Transportation of Dangerous Goods Act, 1992 and Regulations
Sustainable forest licence	Ministry of Natural Resources	Crown Forest Sustainability Act, 1994, S.O. 1994, c. 25
Archaeology approval for development	Ministry of Citizenship and Multiculturalism	Ontario Heritage Act, R.S.O. 1990
Work permit	Ministry of Natural Resources	Public Lands Act, R.S.O. 1990
Crown resource use agreements (for shared use areas)	MEM	Mining Act (R.S.O. 1990)
Fish habitat alteration or destruction authorization	Fisheries and Oceans Canada	Canadian Fisheries Act
Schedule 2 amendment for tailings impoundment area in fish habitat	Fisheries and Oceans Canada and Environment and Climate Change Canada	Metal and Diamond Mining Effluent Regulations
Authorization for works on a navigable water	Transport Canada	Canadian Navigable Waters Act (R.S.C., 1985, c. N-22)

Source: Author.

The environmental assessment process typically takes a minimum of 30 weeks for review and decision, while the environmental compliance approval generally requires about 1 year. These timelines may be extended if additional information is requested or if unforeseen circumstances arise during the review.

Projects that do not require a federal impact assessment are required to complete the provincial permitting process within 2 years. To shorten approval timelines, the Ontario Special Economic Zones Act, 2025, will enable some mining projects within designated zones to receive regulatory exemptions or modified permitting requirements (Environmental Registry of Ontario, 2025). The drive to shorten approval timelines reflects the province's need to secure a domestic supply chain and reduce dependence on foreign suppliers. By replacing lengthy, sequential permitting with the coordinated One Project, One Process framework, the government aims to deliver the regulatory certainty required to attract global investment and meet climate transition goals (MEM, 2025). The Act is part of broader reforms aimed at boosting resource development, strengthening supply chain security for strategic minerals, and expediting the mine approval process, while balancing environmental and social safeguards.

If a project triggers a federal impact assessment, the Impact Assessment Agency of Canada works with the provincial agencies to coordinate the assessment and permitting process; this process must be completed within 5 years.

Under the federal Impact Assessment Act (IAA), federal impact assessments of designated projects must consider the intersection of sex and gender with other identity factors. The Impact Assessment Agency of Canada uses the Gender-Based Analysis Plus (GBA Plus) framework as the practical approach to apply this requirement. For projects assessed only under provincial jurisdiction (i.e., no federal impact assessment is triggered), GBA Plus is not a federal legal requirement; its application is voluntary unless required by the province or by project-specific commitments. GBA Plus incorporates factors such as age, Indigeneity, education, local power dynamics and historical inequities specific to that context (Manning et al., 2018). By embedding these considerations, GBA Plus helps ensure that assessments capture the differentiated experiences of diverse groups and highlight potential inequities in project outcomes. For further guidance and case studies, the IGF's report Integrating Gender into Mining Impact Assessments (Tekinbas, 2022) provides an in-depth analysis of gender-responsive impact assessments in Canada.

In terms of Indigenous Peoples, the legislative framework operates on three levels:

Constitutionally

Treaties signed between Indigenous Peoples and the Crown provide various rights, such as the right to hunt, fish, and pursue traditional practices. These are protected and reaffirmed in the Constitution Act, 1982 (OECD, 2025).

Federally

Canada has adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), including its principle of Free, Prior, and Informed Consent (FPIC)[3] through the 2021 UN Declaration on the Rights of Indigenous Peoples Act (UNDRIPA), which requires federal laws to be interpreted in consistency with the UNDRIPA (Department of Justice Canada, 2025).

[3] For a more in-depth analysis of FPIC provisions that apply to mining projects, see OECD's 2025 report *Mining Regions and Cities in Northern Ontario, Canada,* p. 102.

Provincially

Although Ontario has not incorporated UNDRIP into its provincial legislation, a mandatory Duty to Consult remains in effect under both provincial/territorial and federal governments where an activity could affect Indigenous rights or interests under Section 35 of the Constitution Act, 1982 (Government of Ontario, n.d.). In some cases, the Duty to Consult, or portions thereof, can be delegated to mining companies, although ultimate responsibility remains with the Crown. In 2009, the Ontario Mining Act was revised to strengthen Indigenous rights by requiring mandatory consultation with Indigenous communities at key stages of a project and establishing dispute-resolution processes (OECD, 2025). It is important to note that the Duty to Consult does not generally grant Indigenous communities veto power over mining projects (Ministry of Northern Development, Mines, Natural Resources and Forestry, 2021).

4.0 Socio-Environmental Impacts of Nickel Mining in Ontario

4.1 Energy

Laterite operations require two to six times more energy per tonne of nickel produced compared to sulfide operations (Wyloo, 2024), due to the intensive method of processing laterite ore into nickel products. Sulfide ores are concentrated using mineral processing techniques, which result in concentrates that contain energy (Trytten Consulting Services, 2024). This energy can be used as a fuel source during smelting, reducing dependence on other energy sources required for processing (Wei et al., 2020). Most of Ontario's nickel mining operations rely on the province's power grid, which produces 94% of its electricity from nuclear, natural gas, and renewable sources such as hydroelectric, wind, solar, and bioenergy power, providing one of the lowest carbon electricity profiles in North America (Energy and Mines, 2025). Thus, the carbon intensity of mining in Ontario compared with other jurisdictions is significantly lower (Morgan, 2023).

4.2 Greenhouse Gas Emissions

Nickel sulfide mining and processing emit less greenhouse gas (GHG) emissions, principally in the form of carbon dioxide emissions, than nickel laterite mining. This is primarily due to the smaller overall physical footprint of sulfide mines, reduced soil agitation, and lower energy requirements for crushing, drying, and smelting (Kinnunen et al., 2024) because the ore is concentrated before being further processed. In contrast, laterite ores tend to contain high levels of moisture and require energy-intensive drying, particularly through the rotary kiln-electric furnace (RKEF) process. This is carried out prior to smelting, which also requires high amounts of energy (Wei et al., 2020), further increasing the carbon footprint of laterite ores. Furthermore, in the case of laterite, the whole ore is being processed, either via the high-pressure acid leach (HPAL) or RKEF route, increasing the energy requirement and the associated GHG emissions; refer to Table 3 for a comparison.

TABLE 3. CO_2 intensity of nickel processing routes

Ore type	Process	Product	Tonnes of CO_2 per tonne of nickel (Ni) equivalent
Sulfides	Electric/flash smelting	Refined Ni/matte	6
Laterite	HPAL	Refined Ni/mixed sulfide precipitate/mixed hydroxide precipitate	13.7
Laterite	Blast furnace/RKEF	Nickel pig iron/matte	45.1

Source: Visual Capitalist, 2023.

Historically, nickel ore smelting in Sudbury, Ontario, emitted over 10 million tonnes of sulphur dioxide (SO_2) and tens of thousands of tonnes of metals over nearly a century, leading to severe acid rain, soil acidification, and vegetation loss (Geology for Investors, 2022; Mykytczuk, 2021a; Potvin & Negusanti, 1995). To address these emissions, under Ontario's Environmental Protection Act, Regulation 652/21 (2021) set limits on the discharge of sulphur dioxide from nickel smelting and refining facilities in the Sudbury Area.

BOX 1. VALE'S CLEAN ATMOSPHERIC EMISSIONS REDUCTION PROJECT

Vale, which owns and operates a nickel smelter in Sudbury, reports that its base metals operations in Sudbury emit 100,000 metric tonnes of SO_2 each year, or 30% below Ontario's emissions standard (Vale, n.d.). This was achieved through its Clean Atmospheric Emissions Reduction Project. Further improvements are ongoing, including the installation of an SO_2 scrubber at the nickel refinery, expected to be completed in 2026 (Vale, 2024).

To enhance monitoring and compliance, Vale operates nine air quality stations for particulate sampling, 18 continuous SO_2 monitoring stations (jointly with Glencore's Integrated Nickel Operations), and a mobile monitoring network for ground-level SO_2 (Vale, 2024). In alignment with Ontario's Ambient Air Quality Criteria, results are published quarterly and annually. An Environmental Monitoring Team, comprising representatives from Vale, the community and the Ministry of the Environment, Conservation and Parks, oversees transparency and compliance under Ontario's Nickel Site-Specific Standard Approval framework.

Both the Government of Canada and the Ontario Government are working with the mining sector to support the transition to low-carbon fuel and thereby reduce GHG emissions. The Government of Canada committed CAD 11 million to Glencore Canada to support the deployment of battery-electric equipment to replace diesel-powered machinery at the Craig Mine Onaping Depth Project, which is expected to reduce GHG emissions by over 5,500 tonnes in 2030 (Environment Journal, 2024). Similarly, Canada Nickel received CAD 500,000 from the Government of Ontario's Critical Minerals Innovation Fund to develop its nickel processing facility through its subsidiary, NetZero Metals. The facility will use biochar, a renewable reductant, instead of coal, thereby lowering carbon emissions (Canada Nickel, 2025a).

4.3 Water Quality

One of the key risks of sulfide mining is acid mine drainage (AMD), which can occur when sulfide minerals are exposed to heat and water, triggering a chemical reaction and producing sulfuric acid. This acid can leach heavy metals from tailings or waste rock, contaminating surface and groundwater systems (Chen et al., 2024; Mining & Minerals Today, 2024). AMD can severely degrade water quality, rendering it unfit for drinking, irrigation, or recreation, while bioaccumulated metals in aquatic organisms pose serious risks to human health if contaminated fish are consumed (Mining & Minerals Today, 2024). AMD can also degrade soils and terrestrial ecosystems as toxic metals and other contaminants seep into surrounding environments (Zhang et al., 2024).

At Canada Nickel's Crawford Project in Ontario, seepage collection ditches and collection ponds are designed to capture runoff and slurry water through gravity within the tailings management facility. Water will be treated and discharged or reused as process water (Stantec Consulting Ltd., 2024). However, local environmental groups have expressed their concerns over potential impacts on freshwater systems, as treated effluent will be discharged into the North Driftwood River (Autio, 2025). As of May 2025, the Impact Assessment Agency of Canada requested further information on the project's water management plan, specifically regarding fish habitat offsets, effluent impacts on water quality, sediment contamination risks, and projected changes to ground and surface water levels (Impact Assessment Agency of Canada, 2025).

The SO_2 released from nickel ore smelting in Sudbury historically acidified local rain and lakes, resulting in severe ecosystem damage and the loss of fish populations (Beamish et al., 1975). As SO_2 emissions declined, the water quality of 7,000 acid-damaged lakes improved: pH and alkalinity rose, while sulphate and metal contamination decreased. Reduced acidic deposition also lessened mineral leaching from watershed soils, allowing gradual recovery of aquatic biodiversity. Species with limited dispersal ability (such as fish, mollusks, and amphipods) rebounded more slowly (Tammeorg et al., 2024). Despite these positive changes, residual acidity and metal contamination persisted in aquatic systems near smelter sites, and some remote lakes remained below pH thresholds needed to sustain aquatic life (Gunn et al., 1995). To accelerate recovery, Sudbury's Regreening Program launched extensive watershed rehabilitation in the 1990s, including targeted liming to neutralize acidity and restore aquatic ecosystems (City of Greater Sudbury, 2021). By 2021, 330 lakes near Sudbury had been restored to conditions suitable for fishing and recreation (Mykytczuk, 2021a).

4.4 Land Transformation

Land disturbance from sulfide mining is generally lesser than from laterite mining: the land transformation factor for sulfide mining ranges from 4 to 398 m^2/t nickel, with a median of 30 m^2/t nickel, smaller than the median of 50 m^2/t nickel for laterite mining, which has a land transformation factor range of 7 m^2/t to 229 m^2/t nickel (Mervine et al., 2025).

Land clearing for mines, access roads, and transmission corridors in Ontario's Ring of Fire may destroy the peatlands and wetlands of the Hudson and James Bay Lowlands (Wilt, 2020). Peatlands in Northern Ontario store an estimated 35 billion tonnes of carbon (Wilt, 2020), making them crucial to climate regulation (Struzik, 2021). The James Bay Lowlands sequester about 12 megatonnes of CO_2 annually, equivalent to approximately 7% of Ontario's annual

emissions; while the Hudson Bay Lowlands, one of the world's largest peatland complexes, provide an estimated 10% of the global cooling effect generated by peatlands (Gamble, 2017). Beyond their climate regulation functions, peatlands are a critical habitat for wildlife such as caribou, wolverines, and migratory birds. Disturbances such as mining, drainage, or road construction can reduce peatland's carbon storage capacity, triggering the release of stored CO_2 and methane (Wilt, 2020).

In terms of social impacts, peatlands are of profound importance to the Northern Indigenous communities in Ontario (Aroland First Nation, 2019). They support rich fish, wildlife, and migratory bird populations—including woodland caribou, polar bear, moose, wolverine, gray wolf, and lake sturgeon—and are central to local First Nations' food systems, medicines, cultural and spiritual values, and livelihoods (Aroland First Nation, 2019). Community health and well-being are intimately connected to these lands and waters (Scott, 2024), and these losses encompass spiritual, cultural, and intergenerational dimensions that remain largely invisible in conventional environmental assessments (Canadian Research Institute for the Advancement of Women, 2018).

Forests around Sudbury, Ontario, suffered severe ecological damage in the early 20th century from nickel (and copper) smelter emissions. In response to public complaints, the Ontario government passed legislation in 1915 that protected industry, rather than the environment, by exempting mining companies from liability for smoke damage (Potvin & Negusanti, 1995). Sudbury's Regreening Program, launched in 1978, began liming and land reclamation to restore heavily damaged landscapes (Climatefast, 2022). Since the 1980s, more than 3,400 hectares (ha) of land have been revitalized through liming, grassing, and the planting of over 9.8 million trees and 4,600 shrubs (City of Greater Sudbury, 2021; Mykytczuk, 2021b). The program, one of the largest in the world, initially targeted highly visible sites to improve aesthetics and access for workers but later expanded to include large-scale soil and forest rehabilitation (City of Greater Sudbury, 2021). Combined municipal and industrial programs have restored an additional 4,000 ha of barren land, driven in part by provincial regulations in the 1990s mandating companies to plant trees (Geology for Investors, 2022; Gunn et al., 1995).

4.5 Mine Waste

Ores with high sulfur content are likely to produce sulfur-rich tailings, increasing the risk of acid generation (Trytten Consulting Services, 2024). In Canada, nickel tailings generally contain sulfur, iron, and trace nickel and are usually stored underwater in tailings ponds to avoid exposure to oxygen. Nevertheless, these ponds can become highly acidic over time (Irving, 2023).

Bioremediation and physical remediation are essential strategies for managing tailings and reducing AMD. Bioremediation requires understanding the microbiomes present in tailings, as microbial assemblage can either exacerbate AMD by catalyzing the oxidation of sulfides or help neutralize acidity by forming secondary minerals that can trap and dissolve metals from acidic waters (Peng et al., 2025). Research in Sudbury shows that microbial assemblages differ across legacy tailings sites (Chen et al., 2024). At one site, sulfide-rich, coarse-grained tailings have been exposed to atmospheric weathering for decades, resulting in extensive oxidization, low pH porewater, and high metal contamination. In contrast, another site covered with de-sulfurized tailings—a physical remediation method—maintains circumneutral pH and

lower dissolved metal concentrations, highlighting the effectiveness of physical remediation in reducing acidity and preventing metal leaching (Chen et al., 2024).

Reprocessing tailings is an emerging waste management approach in which minerals such as nickel, zinc, copper, gold, and silver are recovered from tailings using mineral processing technologies. This can reduce AMD risks, potential hazardous materials, the quantity of tailings, and the associated environmental impacts (Hyunjin et al., 2024). An example of a reprocessing tailings project is a multistakeholder initiative between the University of Toronto, industry organizations, and companies, including Vale and Glencore, where bioleaching technologies are being researched to recover nickel from tailings, and to alter the process before sulphate becomes acid (Irving, 2023). If successful, this could provide a new way of tailings management.

Industry and government interest in tailings and emissions management is growing. Canada Nickel, for example, has secured CAD 3.4 million in federal funding to develop its proprietary in-process tailings carbonation technology. At the Crawford Project, this process could permanently store up to 1.5 million tonnes of CO_2 annually at peak production, equivalent to 54 million tonnes over the mine's 41-year lifespan, making the Crawford Project one of Canada's largest carbon storage facilities (Canada Nickel, 2025b; Canadian Mining Journal, 2025). The mine site will cover 2,300 ha, store 495 million m^3 of tailings, and be surrounded by a progressively constructed perimeter dam (Stantec Consulting Ltd., 2024).

4.6 Land Use and Indigenous Peoples' Rights

Indigenous perspectives on nickel development in Ontario are not uniform. Impact assessments in the Far North have been contentious, with disputes over jurisdiction, authority to consent, and which legal frameworks—provincial, federal, or Indigenous—govern environmental and impact assessment processes (Scott, 2024). Many First Nations in Ontario's Far North face economic challenges and view mining as an economic opportunity. For example, some Indigenous communities, including Marten Falls and Webequie, have supported mining development (Wilt, 2020). There are more than 140 active impact benefit agreements (IBAs) between mining companies and Indigenous communities in Ontario (Ontario Chamber of Commerce, 2025). An IBA is legally binding and can set out the terms of how a company and community will work together while outlining a framework for cooperation and collaboration (Mining Association of Canada, n.d.-a). However, other First Nations emphasize their spiritual and cultural relationship with the land and express deep concern about the environmental risks associated with mining. These concerns contributed to strong opposition among some First Nations leaders to the 2024 agreement between Ontario and several First Nations regarding road infrastructure for the Eagle's Nest project (Mining Association of Canada, n.d.-b; Ontario News, 2024).

While not specific to nickel mining in Ontario, it is worth mentioning that the extractive sector in Canada poses specific threats to Indigenous women's security (National Inquiry into Missing and Murdered Indigenous Women, Girls, and 2SLGBTQQIA+ people, 2019). Factors contributing to these risks include transient workforces that are predominantly male, highly paid, and often disconnected from local communities, as well as increased economic insecurity and heightened exposure to drug and alcohol misuse (National Inquiry into Missing and Murdered Indigenous Women, Girls, and 2SLGBTQQIA+ people, 2019). In addition, Indigenous women are often responsible for the protection of water, administering medicinal

plants, harvesting, and preparing and preserving food. These responsibilities mean they are often among the first to experience the effects of changes in water quality, contamination, and shifts in plant potency (Ragu, 2025). Despite their central roles in community health and environmental stewardship, the knowledge of Indigenous women has historically been underrepresented in impact assessments in Canada and globally (Manning et al., 2018).

Under Canada's IAA, regional assessments require the consideration of Indigenous knowledge and specifically reference the need to include perspectives of Indigenous women, youth, Elders, gender-diverse persons, and Two-Spirit[4] people (Impact Assessment Agency of Canada, n.d.). At the time of writing this case study, a regional assessment is underway in the Ring of Fire, jointly agreed upon by 15 First Nations partners and the Impact Assessment Agency of Canada (Impact Assessment Agency of Canada, 2025).

The Ontario Special Economic Zones Act 2025 (Bill 5) is intended to accelerate permitting by enabling exemptions or shortening regulatory requirements for projects located within designated "special economic zones," including Ontario's Ring of Fire (APT News, 2025). First Nations raised concerns that the provisions in Bill 5 risk undermining the duty to consult and the right to FPIC, prompting several constitutional challenges on the grounds that the legislation breaches treaty rights (OECD, 2025). The Chief of Nishnawbe Aski First Nation has further stated that the law will not apply within their territories (Levy, 2025). While streamlined permitting is viewed as essential for Canada's global competitiveness in nickel supply chains (OECD, 2025), Bill 5 requires careful implementation to ensure that expedited processes do not compromise either the government's duty to consult with Indigenous Peoples or environmental protections.

[4] "Two-Spirit: An English term used to broadly capture concepts traditional to many Indigenous cultures. It is a culturally-specific identity used by some Indigenous peoples to indicate a person whose gender identity, spiritual identity, and/or sexual orientation comprises both male and female spirits" (Women and Gender Equality Canada, 2024).

5.0 Strengths and Gaps

5.1 Strengths

Ontario maintains a comprehensive legislative framework governing environmental assessments and permitting, supported by a single online portal that companies need to submit and track permit submissions. Specifically, Ontario's mining activities are governed by the Mining Act, Environmental Protection Act, Environmental Assessment Act, and Ontario Water Resources Act. These collectively regulate permitting, exploration, development, mine closure, and environmental protection, with requirements for environmental assessments and closure plans to be submitted and reviewed (Johnson et al., 2023; Penny, 2012; Young et al., 2022).

As previously mentioned, many mining companies also form IBAs with Indigenous communities, and these commonly include environmental monitoring frameworks (OECD, 2025). For example, Canada Nickel's agreement with the Mattagami, Matachewan, and Flying Post First Nations includes land and environmental monitoring mechanisms, as well as economic and skills development commitments (OECD, 2025).

There is good collaboration between academia and the mining sector. Research into reprocessing tailings, including technologies to recover nickel and reduce acid formation, has the potential to transform tailings management. Government support for carbon-sequestering innovations, such as Canada Nickel's in-process tailings carbonation, demonstrates a growing alignment between industry and government on low-carbon solutions. Partnerships such as Canada Nickel's agreement with NetCarb, which aims to further expand carbon storage capacity, reflect this broader commitment.

Sudbury's Regreening Program illustrates the potential for a multistakeholder approach to rehabilitate landscapes historically affected by nickel mining's pollution, deforestation, and water contamination. The success in reducing emissions, restoring vegetation, and improving lake water quality demonstrates that long-term environmental recovery is achievable. Lessons from Sudbury can inform contemporary practices, including increased use of electric machinery and other low-emissions technologies supported through Ontario's Critical Minerals Innovation Fund.

Regional assessments, such as the one currently underway for the Ring of Fire, will be used to examine the environmental, health, social, and economic effects and benefits of any future development. The analysis will help identify and address the cumulative effects of multiple projects. The Regional Assessment is being co-led by the 15 First Nations and the Impact Assessment Agency of Canada.

5.2 Gaps

Ontario's Special Economic Zones Act, 2025, is intended to facilitate significant economic activities by allowing exemptions from certain legal and regulatory requirements (Bennett & Grbesic, 2025). While such rapid permitting is considered important for Canada's global competitiveness in global nickel supply (OECD, 2025), accelerated timelines must be carefully managed to avoid compromising protections for sensitive ecosystems, species at risk, and Indigenous rights.

Differences between the application of provincial and federal environmental legislation can create gaps or inconsistencies in oversight, monitoring, and enforcement. Inconsistent standards or a lack of coordination may result in environmental considerations being overlooked or inadequately addressed, particularly in cumulative effects management. Likewise, the interplay between federal and provincial jurisdictions also complicates the protection of Indigenous rights. Although Canada's federal framework requires FPIC, some mining projects fall under provincial authority, where legislation may not offer equivalent protections. Along the same vein, the federal government promotes the application of GBA Plus as part of the impact assessment process; however, there is no legal requirement, and women's, including Indigenous women's, voices and knowledge are often not adequately considered in the assessment and decision-making process.

By way of example, the Eagle's Nest nickel-copper-platinum-palladium project, located in Ontario's Ring of Fire, was originally subject to an Environmental Assessment under Ontario's Environmental Assessment Act. In 2025, Ontario passed Bill 5, which removed the requirement for a comprehensive environmental assessment of the Eagle's Nest project. The project falls below the production threshold (i.e., less than 5,000 tonnes per day) to trigger Canada's federal IAA; however, the Neskantaga First Nations made a formal request to designate the project for federal assessment. While the mine will be subject to environmental oversight and Indigenous consultations, at the time of publication, the Impact Assessment Agency of Canada (IAAC) had decided not to designate the Eagle's Nest mine project in the Ring of Fire for an impact assessment (IAAC, 2026). The IAAC based its decision on the alternative environmental protection acts, which may be used to address any adverse impacts (IAAC, 2026). There is a risk that if potential impacts to Indigenous Peoples and the environment are not given due consideration, they may not be adequately prevented and mitigated.

6.0 Conclusions

Ontario has a comprehensive regulatory framework and benefits from a history of collaborative restoration programs to address the environmental and social impacts of nickel sulfide mining.

While nickel sulfide mining typically has a smaller environmental footprint than nickel laterite mining, key issues, such as the generation of AMD, can pose a risk to downstream waterbodies, aquatic ecosystems, and culturally important harvesting areas, resulting in the need for careful management and long-term monitoring.

Given the heightened importance of critical minerals, including nickel, good practices such as the use of regional assessments can help identify potential cumulative effects in a given region where such major projects are likely to be developed.

References

Aroland First Nation. (2019). *Appendix A—Request for regional assessment*. https://iaac-aeic.gc.ca/050/documents/p80468/133833E.pdf

Autio, A. (2025). *Environmental group concerned about impact of nickel mine on freshwater*. The Daily Press. https://www.timminspress.com/news/environmental-group-concerned-about-impact-of-nickel-mine-on-freshwater

Beamish, R. J., McFarlane, G. A., Vanloon, J. C., & Lichwa, J. (1975). *Examination of the possible effects of Sudbury nickel mining and smelting operations on fishes and the water chemistry of lakes within the White Fish Lake Indian Reserve*. Fisheries and Marine Service Research and Development Technical Report, vol. 579.

Bennett, S. D. & Grbesic, I. T. (2025). *Ontario's special economic zones: Key features of the new legislation*. Stikeman Elliott. https://stikeman.com/en-ca/kh/canadian-mining-law/ontarios-special-economic-zones-key-features-of-the-new-legislation

Canada Nickel Company Inc. (2025a). *Canada Nickel is awarded $500,000 from Ontario's Critical Minerals Innovation Fund to advance NetZero Metals Inc.* https://wp-canadanickel-2025.s3.ca-central-1.amazonaws.com/media/2025/01/Canada-Nickel-PR-NZM-CMIF-Announcement-20250115-FINAL.pdf

Canada Nickel Company Inc. (2025b). *Canada Nickel partners with NetCarb to advance next-generation carbon sequestration technology*. https://wp-canadanickel-2025.s3.ca-central-1.amazonaws.com/media/2025/06/Canada-Nickel-Press-Release_NetCarb-News-Release_VF_1_250427.pdf

Canadian Mining Journal. (2025). *Canada Nickel receives $3.4M federal injection to turn nickel mining tailings into carbon storage*. https://www.canadianminingjournal.com/news/canada-nickel-receives-3-4m-federal-injection-to-turn-nickel-mining-tailings-into-carbon-storage/

Canadian Research Institute for the Advancement of Women. 2018. *Strengthening impact assessments for Indigenous women*. https://www.criaw-icref.ca/wp-content/uploads/2021/04/Strengthening-Impact-Assessments-for-Indigenous-Women.pdf

Chen, M., Grégoire, D. S., Bain, J. G., Blowes, D. W., & Hug, L. A. (2024). Legacy copper/nickel mine tailings potentially harbor novel iron/sulfur cycling microorganisms within highly variable communities. *Applied and Environmental Microbiology, 90*(6). https://doi.org/10.1128/aem.00143-24

City of Greater Sudbury. (2021). *Regreening program: 5-year plan 2021-2025*. https://www.greatersudbury.ca/live/environment-and-sustainability1/regreening-program/reports-and-publications/regreening-program-five-year-plan2021-2025-pdf/

Climatefast. (2022). *A reason to hope - The regreening of Sudbury*. https://climatefast.ca/reason-hope-regreening-sudbury

Department of Justice Canada. (2025). *Implementing the United Nations Declaration on the Rights of Indigenous Peoples Act*. https://www.justice.gc.ca/eng/declaration/index.html

Energy and Mines. (2025a). *Protecting Ontario's critical minerals and energy sector* [News release]. https://news.ontario.ca/en/release/1005839/protecting-ontarios-critical-minerals-and-energy-sector

Energy and Mines. (2025b). *Ontario's critical minerals strategy 2022–2027: Unlocking potential to drive economic recovery and prosperity.* https://www.ontario.ca/page/ontarios-critical-minerals-strategy-2022-2027-unlocking-potential-drive-economic-recovery-prosperity

Environment Journal. (2024). *Cutting carbon pollution with funding from Glencore Canada.* https://environmentjournal.ca/cutting-carbon-pollution-with-funding-from-glencore-canada-corporation/

Environmental Registry of Ontario. (2025). *Special Economic Zones Act, 2025.* https://ero.ontario.ca/notice/025-0391

Epiroc. (2022). *Epiroc wins large battery-electric equipment order for new all-electric mine in Canada.* https://www.epirocgroup.com/en/media/corporate-press-releases/2022/20220704-epiroc-wins-large-battery-electric-equipment-order-for-new-all-electric-mine-in-canada#

Gamble, J. (2017). *What's at stake in Ontario's Ring of Fire.* Canadian Geographic. https://canadiangeographic.ca/articles/whats-at-stake-in-ontarios-ring-of-fire/

Geology for Investors. (2022). *Sudbury: Ancient apocalypse to modern resource.* https://www.geologyforinvestors.com/sudbury-ancient-apocalypse-to-modern-resource/

Geology Science. (2023). *Lateritic deposits.* https://geologyscience.com/geology-branches/mining-geology/lateritic-deposits/

Glencore Canada. (2019). *Onaping depth: Collaborating with the EV industry to prepare for mining at depth.* https://www.glencore.ca/en/media-and-insights/insights/onaping-depth-collaborating-with-the-electric-vehicle-industry

Government of Canada. (2021). *An update on the socio-economic gaps between Indigenous Peoples and the non-Indigenous population in Canada: Highlights from the 2021 Census.* https://www.sac-isc.gc.ca/eng/1690909773300/1690909797208

Gunn, J., Keller, W., Negusant, J., Potvin, R., Beckett, P., and Winterhalder, K. (1995). *Ecosystem recovery after emission reductions: Sudbury, Canada.* https://laurentienne.ca/assets/files/Living-With-Lakes/Restoration%20Ecology/Gunn-et-al-1995-WASP.pdf

Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development. (2022). *How will women fit into the mining workforce of the future?* https://www.igfmining.org/women-mining-workforce-future/

Impact Assessment Act, S.C. 2019, c. 28, s. 1. https://laws-lois.justice.gc.ca/eng/acts/I-2.75/

Impact Assessment Agency of Canada. (n.d.). *Policy framework for regional assessment under the Impact Assessment Act.* https://www.canada.ca/en/impact-assessment-agency/programs/impact-assessments-101/policy-framework-regional-assessment-impact-assessment-act.html

Impact Assessment Agency of Canada. (2025a). *Enclosure 1- Comments on the impact statement for the Crawford Nickel Project.* https://iaac-aeic.gc.ca/050/documents/p83857/161765E.pdf

Impact Assessment Agency of Canada. (2025b). *Regional assessment in the Ring of Fire area—milestone reached: Regional assessment in the Ring of Fire area in northern Ontario moves to next phase.* https://www.canada.ca/en/impact-assessment-agency/news/2025/01/regional-assessment-in-the-ring-of-fire-area---milestone-reached-regional-assessment-in-the-ring-of-fire-area-in-northern-ontario-moves-to-next-phase.html

Impact Assessment Agency of Canada. (2026). *Eagle's Nest Mine project—President's response*. https://iaac-aeic.gc.ca/050/evaluations/document/165043

Insidexploration. (2024). *Nickel sulphides vs. nickel laterites: Which is better for batteries and why?* https://insidexploration.com/nickel-sulphides-vs-nickel-laterites-which-is-better-for-batteries-and-why/

Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development. (2026a). *Country profile: Canada*. https://www.iisd.org/system/files/2026-02/country-profile-canada.pdf

Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development. (2026b). *Commodity profile: Nickel*. https://www.iisd.org/system/files/2026-02/commodity-profile-nickel.pdf

International Union for Conservation of Nature and Natural Resources. (n.d.). *Peatlands and climate change*. https://iucn.org/resources/issues-brief/peatlands-and-climate-change

Irving, T. (2023). *U of T Engineering researchers growing microorganisms to recover nickel and clean up tailings ponds*. University of Toronto. https://news.engineering.utoronto.ca/u-of-t-engineering-researchers-growing-microorganisms-to-recover-nickel-and-clean-up-tailings-ponds/

Johnson, E., Ericsson, M., & Löf, A. (2023). The mining permitting process in selected developed economies. *Land Use Policy, 131*. https://doi.org/10.1016/j.landusepol.2023.106762

Kinnunen, P., Riihimäki, T., Kinnunen, K., Salo, M., Heikola, T., & Mäkinen, J. (2024). Process design for direct production of battery grade nickel sulfate. *Journal of Sustainable Metallurgy, 10*(3), 1369–1379. https://link.springer.com/article/10.1007/s40831-024-00864-9

Levy, G. (2025). *Canada's PM wants to fast-track 'nation building'—but can he?* BBC News. https://www.bbc.co.uk/news/articles/cew0kw29lvro

Manning, S., Nash, P., Levac, L., Stienstra, D., & Stinson, J. (2018). *Strengthening impact assessments for Indigenous women*. Canadian Research Institute for the Advancement of Women. https://www.canada.ca/content/dam/iaac-acei/documents/research/Stengthening-Impact-Assessments-for-Indigenous-Women-November-2018.pdf

Mervine, E. M., Valenta, R. K., Paterson, J. S., Mudd, G. M., Werner, T. T., Nursamsi, I., & Sonter, L. J. (2025). Biomass carbon emissions from nickel mining have significant implications for climate action. *Nature Communications, 16,* Article 481, 1–10. https://www.nature.com/articles/s41467-024-55703-y

Mine Connect Canada. (2025). *Canada Nickel joins Equal by 30 Campaign to increase equal representation, improve pay equity for women in mining*. https://mineconnect.com/article/canada-nickel-joins-equal-by-30-campaign-to-increase-equal-representation-improve-pay-equity-for-women-in-mining/

Mining & Minerals Today. (2024). *The hidden dangers of acid mine drainage*. https://m-mtoday.com/news/the-hidden-dangers-of-acid-mine-drainage/

Mining Association of Canda. (n.d.-a). Mining-Indigenous Relations Agreements. https://mining.ca/our-focus/indigenous-affairs/mining-indigenous-relationship-agreements/

Mining Association of Canada. (n.d.-b). *Protocols & guides*. https://mining.ca/towards-sustainable-mining/protocols-guides/

Mining Industry Human Resources Council. (2024). *Canadian mining workplace profile*. https://mihr.ca/wp-content/uploads/2024/04/MiHR-Workplace-EN-2024-Final.pdf

Ministry of Energy and Mines. (2025). *Ontario's critical minerals strategy 2022–2027: Unlocking potential to drive economic recovery and prosperity*. https://www.ontario.ca/page/ontarios-critical-minerals-strategy-2022-2027-unlocking-potential-drive-economic-recovery-prosperity

Ministry of the Environment, Conservation and Parks. (2025). *Ontario's ambient air quality criteria*. https://www.ontario.ca/page/ontarios-ambient-air-quality-criteria#section-4

Ministry of Northern Development, Mines, Natural Resources and Forestry Ontario. (2021). *Consultation framework: Implementing the duty to consult with Aboriginal communities on mineral exploration and mine production in Ontario*. https://files.ontario.ca/co/ndmnrf-consultation-framework-en-2021-12-08.pdf

Morgan, R. (2023, March 30). *Ontario's clean electricity grid becoming dirtier under Doug Ford's government*. The Pointer. https://www.thepointer.com/article/2023-03-30/ontario-s-clean-electricity-grid-becoming-dirtier-under-doug-ford-s-government/

Mykytczuk, N. (2021a). *Sudbury went from a major polluter to a clean city—here's what extractive industries can learn*. The Narwhal. https://thenarwhal.ca/opinion-sudbury-ontario-extractive-industries-transition/

Mykytczuk, N. (2021b). *What mining, oil and gas industries can learn from Sudbury, the city that went from major polluter to thriving environment*. The Conversation. https://theconversation.com/what-mining-oil-and-gas-industries-can-learn-from-sudbury-the-city-that-went-from-major-polluter-to-thriving-environment-165595

Na, H., Eom, Y., Yoo, K., & Alorro, R. D. (2024). A review on the reprocessing of sulfide tailings for resource recovery and AMD prevention using mineral processing methods. *Minerals Engineering, 218,* Article 109025. https://doi.org/10.1016/j.mineng.2024.109025

National Inquiry into Missing and Murdered Indigenous Women and Girls. (2019). *Final report, Volume 1a*. https://www.mmiwg-ffada.ca/wp-content/uploads/2019/06/Final_Report_Vol_1a-1.pdf

Native Women's Association of Canada. (2020). *Indigenous women and impact assessment final report*. https://www.canada.ca/content/dam/iaac-acei/documents/research/nwac-impact-assessment-final-report-en.pdf

Natural Resources Canada. (2023). *Canada's minerals and mining map*. https://atlas.gc.ca/mins/en/index.html

Natural Resources Canada. (2026). *Nickel facts*. https://natural-resources.canada.ca/minerals-mining/mining-data-statistics-analysis/minerals-metals-facts/nickel-facts#L2

Nickel Institute. (2024). *Nickel industry - Part 1 - Processing nickel laterites and sulfides*. https://nickelinstitute.org/en/blog/2024/may/nickel-industry-part-1-processing-nickel-laterites-and-sulfides/

Ontario Chamber of Commerce. (2025). *Mining 2030: Unearthing Ontario's potential*. https://occ.ca/our-publications/mining-2030-unearthing-ontarios-potential/

Ontario Mining Association. (n.d.). *Facts and figures*. https://www.oma.on.ca/ontario-mining/facts-and-figures/

Ontario Mining Association. (2025). *Economic contribution*. https://oma.on.ca/ontario-mining/economic-contribution/

Ontario News. (2024). *First Nations and Ontario one step closer to building all-season roads in the Ring of Fire*. https://news.ontario.ca/en/release/1004265/first-nations-and-ontario-one-step-closer-to-building-all-season-roads-in-the-ring-of-fire

Ontario Ring of Fire. (n.d.). *Nickel*. https://www.orof.ca/critical-minerals/nickel-mine/

Organization for Economic Cooperation and Development. (2025). *OECD rural studies: Mining regions and cities in Northern Ontario, Canada*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/10/mining-regions-and-cities-in-northern-ontario-canada_f986f1ee/d3676159-en.pdf

Peng, Z., Liu, C., Fu, Y., Liu, H., Liu, H., & Cao, H. (2025). Utilization of algal biochar for biopassivation of copper sulfide tailings to reduce acid mine drainage. *Biology, 14*(3). https://doi.org/10.3390/biology14030300.

Penny, A. (2012). *An examination of best practices for mine site reclamation: An investigation of Ontario's recent environmental assessment cases where reclamation is expected* [Master's thesis, Ryerson University]. https://doi.org/10.32920/ryerson.14649327.v1

Potvin, R. R., & Negusanti, J. J. (1995). Declining industrial emissions, improving air quality, and reduced damage to vegetation. In J. M. Gunn (Ed.) *Restoration and recovery of an industrial region*. Springer Series on Environmental Management. Springer. https://doi.org/10.1007/978-1-4612-2520-1_4

Pugliese, K. (2025). *Carney's critical minerals push meets Indigenous realities as Canada races to rival China's supply dominance*. APTN News. https://www.aptnnews.ca/national-news/carneys-critical-minerals-push-meets-indigenous-realities-as-canada-races-to-rival-chinas-supply-dominance/.

Ragu, S. (2025). *Missing and murdered Indigenous women and girls: A national human rights crisis in Canada*. https://www.humanrightsresearch.org/post/missing-and-murdered-indigenous-women-and-girls-a-national-human-rights-crisis-in-canada

Scott, D. N. (2024). *Environmental law for a just transition*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4937536

Stantec Consulting Ltd. (2024). *Crawford Nickel Project impact statement*. https://www.iaac-aeic.gc.ca/050/documents/p83857/159946E.pdf

Statistics Canada. (2021). *Focus on geography series, 2021 census of population: Ontario, Province*. https://www12.statcan.gc.ca/census-recensement/2021/as-sa/fogs-spg/page.cfm?lang=E&topic=8&dguid=2021A000235

Struzik, E. (2021). *Peatlands protect against wildfire and flooding, but they're still under attack in Canada*. Queen's Gazette. https://www.queensu.ca/gazette/stories/peatlands-protect-against-wildfire-and-flooding-they-re-still-under-attack-canada

Sustainability Directory. (n.d.). *Gravity separation*. https://lifestyle.sustainability-directory.com/area/gravity-separation/resource/1/

Tammeorg, O., Chorus, I., Spears, B., Nõges, P., Nürnberg, G. K., Tammeorg, P., Søndergaard, M., Jeppesen, E., Paerl, H., Huser, B., Horppila, J., Jilbert, T., Budzyńska, A., Dondajewska-Pielka, R., Gołdyn, R., Haasler, S., Hellsten, S., Härkönen, L. H.,Kiani, M. … Lürling, M. (2024). Sustainable lake restoration: From challenges to solutions. *Wiley Interdisciplinary Reviews: Water, 11*(2), Article e1689. https://wires.onlinelibrary.wiley.com/doi/10.1002/wat2.1689

Tekinbas, E. (2022). *Global review: Integrating gender into mining impact assessments*. Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development. https://www.iisd.org/system/files/2022-10/integrating-gender-mining-impact-assessments.pdf

Trytten Consulting Services. (2024). *Nickel sulfide processing: Another reason it is "the Devil's Metal."* https://gigametals.com/site/assets/files/5353/nickel_processing_-_the_devils_metal_-_combined_-_march_2024.pdf

Vale. (n.d.). *Dismantling of the superstack*. https://vale.com/sudbury-superstack

Vale. (2024). *2023 Environment management system & community engagement report*. https://vale.com/documents/d/guest/2023-vale-community-engagement-report-31-march-2024

Visual Capitalist. (2023). *How clean is the nickel and lithium in a battery?* https://elements.visualcapitalist.com/how-clean-is-the-nickel-and-lithium-in-a-battery/

Wei, W., Samuelsson, P. B., Tilliander, A., Gyllenram, R., & Jönsson, P. G. (2020). Energy consumption and greenhouse gas emissions of nickel products. *Energies, 13*(21), Article 5664. https://doi.org/10.3390/en13215664

Wilt, J. (2020). *The battle of the "breathing lands": Ontario's Ring of Fire and the fate of its carbon-rich peatlands*. The Narwhal. https://thenarwhal.ca/ring-of-fire-ontario-peatlands-carbon-climate/

Women and Gender Equality Canada. (2024). *2SLGBTQI+ terminology—Glossary and common acronyms*. https://www.canada.ca/en/women-gender-equality/free-to-be-me/2slgbtqi-plus-glossary.html

Woods, R. (1981). Mineral flotation. In J. O. Bockris, B. E. Conway, E. Yeager, & R. E. White (Eds.) *Comprehensive treatise of electrochemistry* (vol. 2). Springer. https://doi.org/10.1007/978-1-4684-3785-0_11

Wyloo. (2024). *Nickel's role in the energy transition*. https://wyloo.com/wp-content/uploads/2024/02/Wyloo-Nickel-Fact-Sheet-2024.pdf

Young, R., Gann, G., Walder, B., Liu, J., Cui, W., Newton, V., Nelson, C., Tashe, N., Jasper, D., Silveira, F., Carrick, P., Hägglund, T., Carlsén, S., & Dixon, K. (2022). International principles and standards for the ecological restoration and recovery of mine sites. *Restoration Ecology, 30*(52). https://doi.org/10.1111/rec.13771

Zhang, Y., Shen, Z., Zhou, W., Liu, C., Li, Y., Ding, B., Zhang, P., Zhang, X., & Zhang, Z. (2024). Environmental problems of emerging toxic metals and treatment technology and methods. *RSC Advances, 14*(50), 37299–37310. https://doi.org/10.1039/d4ra06085g

Appendix A

TABLE A1. Federal and provincial laws and regulations relevant to environmental and associated social impacts of nickel mining in Ontario

Type of legal instrument	Title/description of legal instrument	Federal or provincial	Corresponding section(s) in case study
Constitution	Constitution Act, 1867	Federal	1.6.1
Law	Mining Act, R.S.O. 1990, c. M.14	Provincial	1.6.1, 2.1.2, 2.2, 2.3.1, 2.3.2, 2.4
Law	Environmental Assessment Act, R.S.O. 1990, c. E.18	Provincial	
Law	Environmental Protection Act, R.S.O. 1990, c. E.19	Provincial	
Law	Impact Assessment Act, S.C. 2019, c. 28, s. 1	Federal	
Law	Canadian Environmental Protection Act, S.C. 1999, c. 33	Federal	
Regulation	Metal and Diamond Mining Effluent Regulations	Federal	2.2, 2.4
Regulation	Mining sites—Industry standard under the Local Air Quality Regulation (O. Reg. 419/05)	Provincial	2.1.2
Law	Ontario Water Resources Act, R.S.O. 1990, c. O.40	Provincial	
Law	Endangered Species Act, 2007, S.O. 2007	Provincial	
Regulation	Regulation 854—Mines and Mining Plants (Under the Occupational Health and Safety Act)	Provincial	2.2, 2.4
Law	Far North Act, 2010, S.O. 2010, c. 18	Provincial	2.3.1, 2.3.2
Law	Protect Ontario by Unleashing our Economy Act, 2025, S.O. 2025, c. 4 - Bill 5	Provincial	2.5.1, 3.5.1
Regulation	Ontario's Ambient Air Quality Criteria	Provincial	2.1.2

Source: Author.

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