Environmental and Social Impact Assessment for the Troilus Mine Project

SUMMARY OF RESIDUAL IMPACTs

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Acronyms and abbreviations

%	Percentage
AE	Assurance-emploi (Employment insurance)
ASD	Apatisiiwin Skills Development
CCME	Canadian Council of Ministers of the Environment
CFPBJ	Centre de formation professionnelle de la Baie James (Vocational Training Center de la Baie-James)
CNESST	Commission des normes de l'équité de la santé et de la sécurité du travail
CO	Carbon Monoxide
CoPC	Contaminant of Potential Concern
CV	Valued Component
DFO	Department of Fisheries and Oceans
ESIA	Environmental and Social Impact Assessment
FSS	Fonds de services en santé (Contribution to the health services fund)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
ha	Hectare
km	Kilometer
LSA	Local Study Area
m	Meter
m^3	Cubic meter
mg/l	Milligrams per liter
MTMD	Ministère des Transports et de la Mobilité durable (Ministry of Transportation and Sustainable Mobility)
NO2	Nitrogen Dioxide
PDA	Project Development Area
pH	Hydrogen Potential
PM	Particulate Matter
$PM_{2.5}$	Particulate matter smaller than 2.5 microns
QPIP	Québec Parental Insurance Plan
QPP	Québec Pension Plan
RSA	Regional Study Area
SO2	Sulfur Dioxide
t	Tons
TSS	Total Suspended Solids

27. Summary of Residual Impacts

This chapter provides a summary of the predicted residual impacts for the project and key mitigation measures proposed to avoid, reduce, restore or compensate for the predicted impacts. The characterization of residual impacts as taken from chapters 8 to 24 of the Environmental and Social Impact Assessment (ESIA).

27.1 Summary of residual impacts

Table 27.1 presents a summary of the main mitigation measures and residual impacts for each Valued Component (VC) based on the results of Chapters 8 to 24. The table also summarizes the characterization of residual impacts by identifying direction, magnitude, geographic extent, timing, duration, frequency and reversibility conclusions for each VC.

Table 27.1 Summary of residual impacts

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Atmospheric Conditions								
Change in Ambient Air Quality	C/O	A	H	LSA	MS	MT	IR	R
Change in Ambient Lighting	C/O	A	L	LSA	MS	MT	R	R
• Some contaminants of potential concern (CoPC) will exceed air quality criteria, mainly during the operation phase. • The most problematic are elemental carbon, quartz and mica, with exceedances noted mainly at Cree Camps CC3 and CC4, located near the access road. • Muscovite, actinolite and tremolite also exceed screening level, triggering further assessments, despite their non-asbestiform form, which limits risk. • NO_2 exceeds hourly standards, but not annual ones, while PM2.5 and SO_2 remain below regulatory limits. • Overall, the residual impact on air quality is qualified as having adverse direction, but reversible, with a limited geographical limit. • The residual impact of project lighting is considered low, mainly due to the distance from sensitive receptors such as Cree Camp CC4, and the presence of dense forests that block light. • Construction and operational lighting will comply with current standards, and will include mitigation measures to limit glare, light trespass and light pollution to approximate current conditions. • The residual impact is therefore adverse, but low in magnitude, limited in space, reversible and well controlled.								
Acoustic Environment								
Change in sound climate	C	A	L	RSA	MS	ST	C	R
	O	A	L	RSA	MS	LT	C	R
	D	P	NMC	RSA	MS	ST	C	R
	C	A	L	LSA	MS	ST	IR	R

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Change in vibration environment	O	A	L	LSA	MS	LT	IR	R
	D	P	NMC	LSA	MS	ST	IR	R

- According to the simulations, noise levels generated by mine operations, as well as access road maintenance work and road transport, comply with current noise requirements.
- The impact of the project on the existing acoustic environment in the Local Study Area and the Regional Study Area is considered to be low in amplitude, long-term and reversible once project activities have ceased.
- Regarding the vibration environment, given the distance between the mining facilities and the nearest receptors, residual impacts are expected to be low, short-term and reversible once project activities have ceased. Vibration impacts will occur only occasionally during construction and operation activities.

Climate (Greenhouse Gas Emissions)								
GHGS	C	A	L	G	NS	LT	C	I
	O	A	L	G	NS	LT	C	I
	D	A	L	G	NS	LT	C	I

- The highest GHG emissions during construction are expected in year -1, mainly due to maximum fuel consumption and land-use change.
- Maximum annual GHG emissions for the construction phase are estimated at 69,000 t CO_2 eq, excluding biogenic CO_2 emissions related to deforestation.
- Deforestation generates around 1.99 million tonnes of biogenic CO_2, representing the main source of emissions associated with land use.
- During operation, year 13 is when emissions will peak, at around 158,412 t CO_2 eq, excluding biomass.
- Mobile combustion sources (vehicles and equipment) dominate emissions during operation, with almost 134,000 t CO_2 eq.
- GHG emissions during the decommissioning and closure phase are expected to be lower than during the construction phase, as neither deforestation nor blasting activities will take place.
- The potential use of low- or zero-emission technologies, such as renewable electricity, could further reduce emissions in the restoration phase.
- The project could result in an estimated loss of sequestration capacity of 132,976 t of CO_2 over 100 years, due to the loss of trees and wetlands.

Hydrological Regime								
Changes in hydrological regime	C	P	L	PDA	NS	MT	C	I
	O	A	M	LSA	MS	LT	C	I
	D	A	M	LSA	MS	LT	C	I

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Flow patterns will be disrupted, with changes in peak flows and expected water volumes, altering local hydrological regimes both upstream and downstream. • Natural drainage systems will be disrupted watercourses diversion and the alteration of flow paths, leading to imbalance in regional hydrology. • Mining infrastructure and processing facilities will increase water retention, leading to changes in infiltration and evaporation processes. • Impacts will vary by locations, with some strategic points, such as the area between DC/Bibou and Lake A, experiencing significant reductions in peak flows, while other areas, such as Lac Amont, will see more modest changes. • Some of these changes will be long-lasting, such as the flooding of mining pits and the modification of flow paths, which may last beyond the end of mining, having a lasting effect on the hydrological balance. • The transition to a more natural hydrological regime will remain incomplete, leaving residual impacts that will influence the quality and regulation of water flows over the long term.								
Surface water quality								
Modification of physico-chemical parameters of the receiving environment	C	A	L	LSA	HS	LT	C	R
	O	A	M	RSA[a]	HS	LT	C	R
	D	A	M	LSA	HS	LT	C	R
• Impacts on surface water quality during the construction and decommissioning phases have not been modeled quantitatively, resulting in significant uncertainty. Only qualitative assessments have been made, based in part on results from the 21st year of operation. • No ore or waste rock extraction is planned during the construction phase. Consequently, no new impacts on water quality are anticipated, apart from those already present under current reference conditions. • At decommissioning and closure, the pits will be backfilled to create lakes, which could reduce leaching of contaminants from the tailings. The cessation of pit dewatering will also reduce metal and sulphate releases. However, a hydrogeological model is required to fully assess these impacts. • Exceedances of environmental criteria (arsenic, cadmium, selenium, etc.) are anticipated up to junction 27, but not at junction 28. Impacts would therefore be confined to the Local Study Area (LSA) and would affect only a minor portion of the Regional Study Area (RSA). • Water quality predictions depend on maintaining a pH between 7 and 8. If this range is not respected, the modeling results become invalid. If necessary, limestone will be added to correct the pH in the sedimentation basins.								
[a]Moderate impacts on surface water quality are expected up to junction 27, and no regulatory exceedances other than those reported under initial conditions for the current environment are observed at junction 28. This is located directly at the LSA boundary.								
Hydrogeology								
Lowering or raising of aquifer levels	C	A	H	LSA	MS	ST	C	I
	O	A	H	LSA	HS	MT	C	I
	D	A	H	LSA	MS	MT	C	I
	C	A	NMC	PDA	MS	ST	C	R

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Reducing the flow of community springs and wells	O	A	NMC	PDA	HS	MT	C	R
	D	Neutral	NMC	PDA	MS	SE	C	R
Reduced recharge of local aquifers	C	A	M	PDA	HS	ST	C	R
	O	P	M	PDA	HS	ST	C	R
	D	P	M	PDA	HS	LT	C	R
Drainage of aquifer-dependent wetlands and watercourses	C	A	H	LSA	MS	ST	C	I
	O	A	H	LSA	MS	MT	C	I
	D	A	H	LSA	MS	LT	C	I
• Mining activities will result in a significant drawdown of groundwater levels e, caused by the pumping required to keep the pits dry. • This drawdown could reach a depth of several hundred meters near the pits, and extend over several kilometers, affecting hydraulic gradients and downstream uses (water intakes, wetlands, ecosystems). • The Bibou Creek diversion will have a permanent and irreversible impact on the local hydrogeological regime, particularly in sensitive areas near pits J and 87. • Natural aquifers recharge will be reduced in some areas due to deforestation, soil stripping and the installation of infrastructure that will limit surface water infiltration. • However, the development of the waste rock pile, made of permeable materials, will promote a gradual increase in long-term recharge, reaching around 71,749 m³/d at the end of the project, compared with 55,156 m³/d initially. • Natural groundwater rise is expected at site closure, but some of the impacts from deep drawdown will remain irreversible, particularly near the pits and in certain wetlands. • Community wells and springs could see their flow reduced because of the piezometric depression. However, these impacts are largely reversible and can be offset by technical measures (replacement wells, relocation of water intake).								
• Wetlands and lakes dependent on aquifers will experience uneven impacts: some areas will experience a reduction in their water supply, while others will see increased infiltration. • Some lakes, like PE44, will experience a persistent decline in recharge, while others may benefit from partial recovery or long-term increased infiltration. • Hydrogeological impacts are considered to be mostly adverse, localized within the LSA, sometimes irreversible, but partially mitigated over the long term through infrastructures that promotes recharge and groundwater level rising.								
Groundwater Quality								
Metal contamination	C	A	L	PDA	MS	LT	C	R
	O	A	L	PDA	MS	LT	C	R
	D	P	L	PDA	MS	LT	C	R
Hydrocarbon contamination	C	Neutral	L	PDA	MS	MT	IR	R
	O	Neutral	L	PDA	MS	MT	IR	R
	D	Neutral	L	PDA	MS	MT	IR	R
	C	A	L	PDA	MS	ST	C	R

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Nutrient or nitrate enrichment	O	A	L	PDA	MS	ST	C	R
	D	A	L	PDA	MS	ST	C	R

- Residual risk of groundwater metal contamination remains, despite mitigation measures.
- Construction and operation phases: pumping creates a drawdown that acts as a hydraulic barrier, directing water toward the pits for treatment.
- Critical closure phase: groundwater level rising can alter underground flows, requiring adaptive management to protect water in the long term.
- The risk of hydrocarbon contamination is localized to the PDA, mainly due to accidental leaks or spills.
- Thanks to containment, clean-up measures and post-closure monitoring, such contamination is generally reversible, although its duration may vary depending on the speed of response.
- The most sensitive periods (moderate) are during spring melt or heavy rain. Post-closure monitoring is planned to limit long-term impacts.
- Nutrient or nitrate enrichment in groundwater represents a low risk, mainly associated with industrial effluents, the use of explosives, organic matter management and sanitary facilities.
- This risk is effectively controlled by measures such as wastewater treatment, waste management and site rehabilitation, making impacts on water quality limited, reversible and short term.
- The closure phase requires long-term monitoring to minimize any persistent residual contamination, particularly concerning metals and hydrocarbons.

Soils and Sediments								
Human exposure to contaminated soil	C	A	L	PDA	NS	ST	IR	R
	O	A	M	PDA	NS	MT	IR	R
	D	A	L	PDA	NS	LT	S	R
Soil and sediment instability and erosion	C	A	M	PDA	NS	MT	C	R
	O	A	M	PDA	NS	MT	C	R
	D	A	L	PDA	NS	MT	C	R
Alteration of soil and sediment quality	C	A	M	PDA	NS	ST	C	R
	O	A	M	PDA	NS	ST	C	R
	D	A	L	PDA	NS	ST	C	R

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Residual impacts related to human exposure to contaminated soils are low, limited to the PDA, short-term or accidental, due to access restriction measures already in place. • Mining infrastructure (stockpiles, tailings ponds, stockpiles) may cause erosion and deposition affecting sediment quality, but these impacts are punctual, manageable and spatially limited. • Closure work will involve remediation of contaminated soils to make them suitable for future use, making the expected impacts long-term but reversible, and confined to the project area. • Soil instability and erosion may occur irregularly, depending on weather conditions and discharge intensity, but the planned water management measures will limit impacts to a low magnitude and a restricted perimeter. • Soil losses due to erosion are considered reversible, particularly through water flow control and surface stabilization measures. • Impacts related to soil compaction may occur during certain phases (e.g. decommissioning), but they would be short-term, reversible and low in magnitude. • Alteration of soil and sediment quality in the event of accidental spills or leaks would be limited by containment and rapid recovery measures, keeping impacts low to moderate and reversible. • All soils affected by project activities will have to be restored or evacuated to an authorized treatment site, thus ensuring that the final soils meet current quality criteria.								
Vegetation, Riparian and Wetland Environments								
Change in diversity of terrestrial communities and species	C/O/D	A	L/M	PDA/LSA	NS	MT-LT	S/IR/C	R
Change in wetland and riparian cover and functions	C/O/D	A	M	PDA/LSA	NS	LT	S/IR/C	R/I

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Plant species of interest to the Cree will experience direct losses during construction due to vegetation clearing, but these species are common and widely distributed through the region. The impact is considered low in magnitude, long-term, but reversible once activities have ceased. • No plant species at risk have been identified in the project area, so no loss or alteration of this type of species is anticipated. • Invasive alien species, including reed canary grass, could be introduced or spread during the construction, operation and decommissioning phases. However, effective control measures are planned, making potential impacts short-term and reversible. • Stand of Phytosociological Interest, notably mature white birch stand, will be affected over a small area (around 5 ha, or 2% of the RSA's birch stand), but these losses are offset by the presence of regenerating stands, limiting the scale of the impact. • Terrestrial habitats fragmentation will result in the loss of approximately 703 ha of natural environments (mainly softwood stands), representing 11% of the Local Study Area. This fragmentation will also cause edge impacts, such as changes in light and microclimate, which could affect species composition. • Temporary encroachments will also occur (approx. 26.5 ha), but these areas will be restored at the end of construction, limiting short-term impacts. • During the operating phase, direct impacts will be reduced, but indirect impacts such as dust deposition and edge impacts will continue to affect vegetation. • At closure, reclamation with native species should enable progressive recovery of natural environments, limit the spread of invasive species and improve the size and diversity of plant communities. • The "avoid-minimize-compensate" approach guided the project design to limit the loss of wetlands and riparian areas, notably by reusing existing infrastructure and adapting the placement of certain waste rock piles to avoid sensitive environments. • Despite these efforts, construction will result in a direct loss of approximately 415 ha of wetlands and riparian areas, representing about 21% of their surface area in the LSA. Losses will mainly affect open ombrotrophic peatlands and wooded peatlands. • Temporary encroachments of 22 ha (or 1.1% of the LSA's wetlands and riparian areas) are also anticipated during construction but will be restored after the work is completed. • The Bibou Creek diversion will result in temporary local losses of riparian habitats, but also in the creation of new habitats. A drawdown of the water table is possible, but according to the hydrogeological model, most wetlands in the LSA, with their low groundwater recharge, should not be affected. • In addition to direct losses, edge impacts (related to light, wind and hydrology) are anticipated. These impacts could lead to the drying out of certain plant communities and extend beyond the PDA to the LSA and occasionally the RSA.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• During the operational phase, direct impacts will be low, but some work (e.g., expansion) could result in additional disturbance. The main impacts will be indirect, such as those associated with vegetation management around the facilities. • Dewatering of the pits could temporarily lower the groundwater table, but wetlands should not be significantly affected according to available analyses. • Accidental hydrocarbon spills are possible, but the risks are low and confined to the PDA. Appropriate prevention and management measures are planned. • At project closure, no additional measurable adverse impact is expected on wetlands and riparian areas, since the areas concerned will already have been affected during previous phases. • In summary, the loss of wetlands and riparian areas is considered moderate and limited within the PDA. Residual impacts will be partially reversible, but some areas may not fully regenerate during reclamation.								
Terrestrial and Avian Fauna								
Disturbance of wildlife and its habitat	C	A	M	PDA/LSA	HS	MT-LT	C	R
	O	A	L	PDA/LSA	HS	MT-LT	C/IR	R
	D	A/P	L	PDA/LSA	HS	ST	C	R
Risk of Mortality	C	A	L/M	PDA/LSA	HS	LT	IR/C	R/I
	O	A	NMC/L	PDA/LSA	HS	LT	IR	R/I
	D	A	NMC/L	PDA/LSA	HS	LT	IR	R/I
Change in movement patterns	C	A	NMC/L/M	PDA/LSA	HS	LT	C	R
	O	A	NMC/L	PDA/LSA	HS	LT	C	R
	D	A/P	NMC/L	PDA/LSA	HS	LT	C	R
• A 750 m buffer zone around disturbances generates an estimated loss of 756.33 ha (0.97% of the LSA) of suitable habitat for woodland caribou. • The rate of residual disturbance in the RSA will reach 57.3%, which is high, but remains below the federal critical threshold (65%), although fragmentation can adversely affect habitat quality. • Black bear and small wildlife will permanently lose about 1116 ha of habitat (11.2% of the LSA), but their generalist nature should allow them to persist. • Moose will suffer a permanent loss of 113 ha of general habitat and 723 ha of calving habitat, which could locally reduce available resources during sensitive periods. • Southern bog lemming and other small mammals will lose 1,116.62 ha of permanent habitat (11.23% of the LSA) and 59.40 ha temporarily, with a moderate impact due to the availability of similar habitats.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Bats will lose between 753 and 1,185 ha of roosting and feeding habitat (up to 10% of the LSA) and will be subject to indirect disturbance from noise, light and vibration, which may affect their echolocation and site use. • More than 1,200 ha of terrestrial and wetland habitats will be lost for herpetofauna, including common garter snake and certain salamanders. • Changes to the hydrological regime, although uncertain, could disrupt the quality and availability of wetlands. • Noise and light from activities could affect the reproduction and physiology of several amphibians. • Many breeding bird species will experience habitat loss, exacerbated by edge impacts and noise and light disturbance. • More than 11% of waterfowl, shorebird and waterbird habitats will be disturbed, as well as nearly 10% of raptor habitats, without directly affecting nesting sites. • Eight bird species in a precarious status will see encroachment on their preferred habitats, with over 90% impact on the bank swallow. • Four forest groups will lose more than 15% of their area in the LSA, including young cuts, jack pine and mature resinous. • At the end of the project, rapid revegetation will encourage the gradual return of many species, but permanent residual impacts on certain habitats will remain. • The use of the existing mine footprint and the implementation of mitigation measures will limit the magnitude and duration of impacts on terrestrial and avian wildlife, with low projected direct mortalities at the RSA scale. • Woodland caribou face a low risk of mortality, due to the rarity of collisions, their natural avoidance of roads and the presence of measures to detect their presence early and ensure their protection. • The risk of road collisions is higher for moose, attracted by road salts and roadside vegetation, especially during periods of rutting or long-distance movements. This species, along with black bear and wolf, could be affected by the increase in roads, which facilitates their movement, but also hunting. • An increase in the number of moose in the area could lead to an increase in their natural predators (black bear and wolf), which could indirectly increase pressure on other vulnerable species such as caribou. • The risk of mortality for small wildlife depends on the timing of the operations relative to their life cycles; migration, breeding or hibernation periods are the most critical, although some species such as lynx avoid roads. • For beavers, lodges destruction could cause mortality, particularly in autumn or winter. Relocation in July is preferable to minimize this risk. • Small mammals are vulnerable during deforestation and stripping because of their low mobility, making them invisible to machinery operators.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Bats may be affected by the vegetation clearing and demolition of buildings hosting colonies. They are generally mobile, except during the maternity season, when the risk is higher. • Herpetofauna, notably amphibians and common garter snake, are highly sensitive to disturbance (roads, deforestation, habitat destruction); risks are heightened during migration, hibernation or breeding periods. • Avifauna are at risk of mortality during tree cutting and vegetation clearing, especially forest birds, birds of prey and wetland birds, but measures to avoid nesting periods will limit these impacts. • The risk of road collisions for birds mainly concerns species that hunt, nest or feed along roadsides (owls, passerines, crows), but should be reduced by speed-limiting measures. Habitat disturbance could cause some species to modify their movements to access more suitable environments, while others could benefit from the edge habitats created. • Roads can act as barriers for some species, but as corridors for others, depending on their behavior and tolerance. • For caribou, roads may constrain movement, but as the project is located in an area already avoided by the species, the impact on connectivity remains limited. • Recent data show a tendency for caribou to avoid the PDA and access roads, although some low-traffic roads may be used during migration. • Habitat fragmentation could force bats to travel longer distances, with some roads acting as barriers, even narrow ones. • However, new corridors, such as forest roads, the power line and the Bibou Creek diversion, could encourage their movements, especially for the little brown myotis. • Artificial lighting could disrupt chiropteran movement and feeding behaviour, increasing the risk of predation or attracting prey, depending on the context. • For small fauna, roads can facilitate movement to new habitats, but reduce connectivity, particularly for low-mobility species such as amphibians. • Mitigation measures such as culverts can reduce fragmentation impacts. • Impacts on birds are considered low due to their high mobility, despite possible changes in the use of certain habitats.								
Fish and Fish Habitat								
Change in Fish Habitat	C/O/D	A	H	LSA	MS	LT	C	I
Change in Fish Health, Growth or Survival	C/O/D	A	H	RSA	MS	LT	C	I

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• The project will result in direct, temporary or permanent, loss of approximately 164.2 ha of fish habitat, mainly in Bibou Creek and its tributaries. • A permanent modification of 156.9 ha and a temporary alteration of 7.2 ha are anticipated in connection with mining infrastructures. • The entire main tributary of Bibou Creek (2.7 km), the upstream lake chain, and approximately 4.1 km of watercourses between Lac PE29, Lac A and a tributary of Lac A will be lost or altered. • On the eastern side of the PDA, approximately 4.1 km of watercourses (between Lake PE29, Lake A and a tributary of Lake A) will be affected or covered. • Construction of Bibou Creek diversion canal will result in the loss of approximately 109.3 ha of aquatic habitat, and will aim to partially maintain aquatic connectivity between Lake Amont and Lake A. • On the east side, covering of the watercourse between Lake PE29 and Lake A will prevent the fish movement between these two lakes. • On the west side of the PDA, fish passage will not be affected, as the planned infrastructure does not include any new obstructive crossings. • Reduced flow during spring freshet could limit access to spawning, nursery and feeding habitat, particularly for northern pike. • Lower water levels could reduce overwintering habitat volumes, particularly in Lac A and Lac Amont, by limiting dissolved oxygen under the ice. • Burbot could lose shallow spawning habitat because of lower water levels. • The entire shoreline of Lake A, used for nursery and rearing, could be affected by lower water levels. • Temporary increases in total suspended solids (TSS) are possible during the construction, operation and closure phases, despite mitigation measures. These impacts are considered low, localized and reversible. • Several water quality parameters will exceed recommended guidelines, including sulphate, hardness and pH, potentially causing sublethal or lethal impacts on aquatic biota in the LSA. • Aluminum: Concentrations up to 600 µg/l could cause fish mortality, particularly through gills accumulation, despite a low bioaccumulation potential. • Copper: Maximum concentrations nearing 100 µg/l could cause chronic or sublethal impacts (reproductive, locomotor or feeding disorders) and mortality of aquatic organisms. • Selenium: Concentrations up to 3.9 µg/l could cause malformations, neurological disorders and affect fish growth and reproduction. • Cadmium: Concentrations of up to 1.6 µg/l could cause oxidative stress, enzyme disruption and bioaccumulation in tissues, disrupting the food web. • Uranium: Predicted average concentrations (up to 19.4 µg/l) could reduce the abundance of sensitive invertebrates and impair food availability for fish. • Ammonia: Peaks of 132.5 µg/l, above the standard (19 µg/l), could lead to convulsions, hyperventilation and fish mortality, especially at high pH levels.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Effluent from the sedimentation basins could slightly modify the temperature of Bibou Creek, with no significant impact expected on receiving environments due to thermal management measures. • Atmospheric deposition of contaminants has not been assessed in detail, but residual impacts on fish and biota (eutrophication, acidification) are considered minimal. • Underwater noise, mainly from blasting or drilling, could affect sensitive species such as white suckers, but mitigation measures should limit impacts to a negligible level. • No permanent water intakes are planned; temporary intakes will be equipped with screens compliant with DFO standards, reducing the risk of fish entrainment, including at sensitive stages. • Forage fish, especially buried eggs and larvae, are at risk of stranding or physical injury during in-water construction work but fish salvage operations and compliance with regulatory timing windows will reduce these impacts to a low level. • The risk of introducing aquatic invasive species or diseases is low, thanks to strict cleaning, decontamination and equipment management measures. • In the event of accidental introduction, the consequences for the aquatic ecosystem could be high; a specific management plan will be implemented and updated as necessary. • A no-fishing policy will apply to all personnel during their work shifts, to limit fishing pressure on sport species in environments close to the site. • The reduction in wetted area will result in a lower density of benthic invertebrates, mainly chironomids. • Exceedances of water quality standards (CCME) for several contaminants are expected to cause sublethal or lethal impacts on invertebrate communities. • A decrease in invertebrate abundance and diversity could adversely affect fish health, growth and survival in the LSA; these impacts would be moderate, localized, irreversible and lasting throughout the project.								
Land and resource use								
Change in Cree land and resource use	C/O/D	A	M	LSA	MS/HS	LT	C	R
Change in land and recreational resources use for Jamesian communities	C/O/D	A	H	C	MS/HS	MT	C	R
Change in navigation	C/O/D	A	H	PDA	MS	MT	C	I

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Tree cutting, vegetation clearing, soil stripping, earthworks, construction of mining infrastructures and possibly water and waste management will result in the loss of harvesting sites in the PDA and a reduction in harvesting success in the LSA. • Construction activities, transportation and the presence of workers will cause disturbances likely to disrupt Cree land use and recreational activities. • During the operation phase, disturbances related to blasting, ore processing and traffic could disrupt traditional land uses, despite the intermittent and reversible nature of noise and vibrations. • The transportation of mining concentrate and the delivery of goods and services, especially around Mistissini, Oujé-Bougoumou and Chapais, will increase traffic and the risk of accidents, and could adversely affect land use. • Even if employees use organized transportation, their presence in the LSA could generate disturbances and increase pressure on resources. • Temporary restrictions on access to certain areas used by the Cree (such as lakes PE2, PE60, PE61 and PE43) are planned for all phases of the project but will not affect navigation. • The overall residual impact on land use and recreational resources is considered adverse, moderate in magnitude, long-term, continuous, but reversible. • No waterbodies used for fishing or camping will be affected by the project, and Nibiischii Corporation's recreational areas will remain accessible. • The new mining infrastructure will not affect wildlife reserve areas used for recreational purposes. • The Bibou Creek diversion is designed to maintain aquatic connectivity, with no impact on fishing or target species, but access will be restricted for safety reasons. • Hunting and trapping activities, reserved for Indigenous people, will not be affected, and access restrictions for non- Indigenous remain unchanged. • Hunting zone 22, which is rarely used and located far from the mine site, will not be affected by project activities. • The Pavillon Square-Tail Lodge outfitting operation will remain accessible, with road safety measures to limit conflicts with mining traffic. • Noise, dust and lighting levels will meet current standards, without causing a disturbance to recreational users. The project could lead to an increase in non-Indigenous visitation, increasing pressure on certain fishing areas, while promoting the economic viability of the reserve and outfitting operation. • The residual impact on recreational lands and resources is considered negative, of low magnitude, limited to the LSA, moderately to highly sensitive, of medium-term, continuous and reversible. • The project will mainly affect non-navigable watercourses, and infrastructure has been designed to limit encroachment and preserve potential uses, including navigation.								
• Some developments, such as the waste rock piles, will result in the loss of aquatic ecosystems and trails, removing access to certain waterbodies in the PDA, but without affecting recognized navigable waters. • No significant reduction in downstream water volumes is expected, thanks to hydrological mitigation measures and the buffering effect of Lake PE43. • Waterbodies actually used for recreational navigation by visitors (e.g. lakes Frotet, Troilus, Regnault, Avranches, Robineau) will not be affected by the project. • The residual adverse impact on navigation is considered, low in magnitude, limited to the ZDP, moderately sensitive, medium-term, continuous and irreversible due to the lasting modifications to the water regime.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Infrastructure and Services								
Change in the availability of temporary accommodation and housing	C/ O	A	M	LSA/RSA	N/A	ST-MT	C	R
	D	A	L	LSA/RSA	N/A	ST	C	R
Change in demand for services and infrastructure	C/ O	A	M	LSA/RSA	N/A	ST-MT	C	R
	D	A	L	LSA/RSA	N/A	ST	C	R
Change in demand for transport infrastructure	C/O/D	A	M	LSA/RSA	N/A	ST-MT	C	R

- The project will result in a significant influx of workers from outside the region, generating increased pressure on housing availability in the communities of Chibougamau and Chapais, especially in terms of affordable rental housing or housing adapted for families and vulnerable individuals (e.g., seniors, single-parent families).
- During the construction phase, approximately 715 workers will come from outside the region, and 422 during the operating phase. Despite onsite accommodations, many will require housing in nearby communities.
- Some commuters may turn to hotels, particularly during the construction phase. While this will generate economic benefits for the tourism sector, it could also restrict access to temporary accommodation during the peak tourist season.
- The residual impact on housing availability is considered moderate, regional in scope (LSA / RSA), will be continuous, will extend to the medium term, and will particularly affect the most vulnerable segments of the residential market.
- To mitigate this impact, Troilus is committed to promoting local hiring through partnerships with training institutions (CFPBJ, ASD, Cégep de St-Félicien) and to encouraging the sustainable settlement of the workforce in the region through various strategies and incentives.
- Troilus will work with municipalities and housing providers to anticipate needs, promote coherent planning and support residential development in the short and long term.

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• If mitigation measures and urban planning efforts by municipalities are effective, the residual impact could become positive, by stimulating the development of new permanent and temporary housing in the region. • Accidents at the mine site could increase pressure on health and emergency services, wich are already limited in the region, although the presence of a nurse and possibly a doctor on site will help limit this effect. • An internal fire protection service and collaboration with the emergency services are designed to reduce external calls except in cases of force majeure. • The use of water resources and wastewater treatment directly on the mine site limits pressure on existing municipal infrastructures. • The arrival of new employees and their families could increase demand for health, education and daycare services, in a regional context marked by labour shortages and partial closures of certain services. • Additional pressure on social services could result in community tensions, higher crime rates or overburdened police services, notably due to cultural or salary differences. • Cultural diversity training and integration policies will be implemented to mitigate tensions between indigenous, non-indigenous and resident employees. • The overall residual impact on infrastructure and services is considered low to moderate, extend over the medium term, continuous, and located in the LSA/RSA. • Despite these negative impacts, positive impacts are possible, such as support for local training centers and the contribution of new residents to municipal taxes and economic development. • The mining project will result in increased use of the existing access road (Route du Nord) by trucks, buses and construction vehicles, increasing disturbance and accident risks for other road users. • In the construction phase, around 28 daily passages are expected, rising to 29 in the operating phase. Despite this increase, the impact on road infrastructure is considered low, as volumes remain low in relation to the capacity of existing roads, according to MTMD data. • Regular heavy-vehicle use could accelerate pavement deterioration, particularly on the Route du Nord and the segments used to transport concentrate. • An increase in traffic at the Chibougamau-Chapais airport is possible during the construction phase, but this impact is considered low thanks to the measures put in place to encourage local hiring and the permanent settlement of workers in the region. • During the closure phase, transportation requirements will drop considerably (5 to 30 employees), making pressure on infrastructure negligible. • The overall residual impact on transportation infrastructures is considered moderate, continuous, reversible, limited to the LSA/RSA and extending over the medium term, despite the mitigation measures put in place.								
Economic Conditions								
Change in Employment	C	P	H	LSA/RSA	PS	ST	C	R
	O	P	H	LSA/RSA	PS	MT	C	R
	F	A	M	LSA/RSA	NS	ST	C	IR
Change in Business	C	P/A	M	LSA/RSA	NS	ST	C	R
	O	P/A	H	LSA/RSA	NS	MT	C	R
	D	P/A	M	LSA/RSA	NS	ST	C	IR

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Change in Provincial Economy	C	P	M	LSA/RSA	NS	ST	C	R
	O	P	M	LSA/RSA	NS	MT	C	R
	D	A	M	LSA/RSA	NS	ST	C	IR

- The residual impact on employment in the LSA will be positive overall during the construction and operation phases, due to the creation of a significant number of jobs. These positive impacts will be substantial during the active life of the project, but short to medium in duration depending on the phase (short construction, medium operation).
- The majority of jobs created will not be filled locally due to a lack of skilled labour, which constitutes a negative residual impact on local participation.
- The project may reinforce inequalities in access to employment, particularly to the detriment of local women and indigenous. Inclusion measures will enable certain under-represented groups to benefit from opportunities, but the impacts will be limited on overall equity at the LSA level.
- The use of outside labour will result in residual impacts on the local employment structure, limiting sustainable benefits for LSA and RSA residents.
- The end of the project will lead to a sudden loss of jobs, generating an irreversible negative economic impact that will be difficult to offset locally.
- Training and skills development measures, however, will have positive residual long-term impacts for local workers, even after the end of the project.
- The overall residual impacts will therefore result in a temporary but structuring contribution of jobs and skills to the region, with limits in terms of social justice and sustainable inclusion.
- The project will lead to a significant change in regional economic activity, mainly through the growth of mining activity, to the potential detriment of other sectors. This will create an impact of economic specialization in the mining sector, increasing the region's dependence on this industry.
- Implementation of the project could weaken economic diversification by diverting local labour and resources to the mining sector.

- This increased concentration in a single sector makes the regional economy more vulnerable to economic cycles and eventual mine closure.
- Pressure on the local workforce is expected, possibly leading to shortages in other sectors and affecting their competitiveness.
- Higher wages in the mining sector will put upward pressure on regional companies' wage bills.
- Overall, the residual adverse impacts of change on economic activity are considered moderate, irreversible, extending over the long term, and not very resilient without structural mitigation measures.

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• The project will generate moderate positive residual economic benefits during the construction and operation phases, primarily through job creation and GDP stimulation. • In the construction phase, some 3,496 jobs will be created, generating $445.8 million in value-added, including $260.1 million in wages, with direct tax benefits for governments estimated at $100.7 million. • In the operating phase, 20,942 jobs are expected to be created, contributing $3 billion to GDP (including $1.9 billion in wages), with total tax benefits estimated at $912.5 million. • A significant proportion of spending is lost outside Quebec through economic leakage, reaching 65.8% in construction and 52.5% in operation, which limits local spin-offs. • Parafiscal taxes (CNESST, FSS, RQAP, RRQ, AE) represent a significant portion of government revenues, particularly for Quebec, with $338 million generated during operations. Direct tax benefits for municipalities are limited, except for approximatively $0.5 million in municipal taxes collected during construction. • The project could indirectly reinforce the specialization of the mining economy in the region, supporting long-term labour market activity, although this impact remains uncertain. • The improvement measures put in place could generate positive spinoffs for certain vulnerable populations (e.g. Indigenous, local and women-owned businesses), although structural inequalities will not be resolved at the LSA level. • Closure of the project will lead to a significant and irreversible decline in project-related economic activity, creating a "shock" effect in the region. • The uneven economic impact could accentuate socio-economic disparities on a regional scale if not accompanied by rebalancing measures. • Overall, the residual economic impacts of the project are considered positive, moderate and reversible during construction and operation, but negative and irreversible after closure, with an estimated resilient socio-economic impact. • Residual adverse impacts on the health of indigenous populations are low to moderate, with health conditions likely to remain similar or slightly worse than initial conditions, without being eliminated. • Fish consumption is a major route of exposure to metals, particularly mercury, which is already present in the region. Measured concentrations generally remain below health thresholds. • Modelling predicts that NO2 and PM2.5 concentrations could exceed health thresholds, justifying monitoring and mitigation measures.								
Health								
Health Conditions	C/O/D	P/A	L/M	LSA/RSA	NS	ST-MT	IR/R	R
• Project activities could alter wildlife movements patterns, impact food security and harvesting practices, and affecting social determinants of health such as community cohesion. • Changes in food quality, land use and aesthetics could reduce the availability and consumption of traditional foods, influencing physical health, as well as recreational, spiritual and cultural activities. • Worker camps could lead to negative social impacts (increased sexually transmitted infections, discrimination), despite the measures in place, with some forms of racism and stigmatization remaining out of control. • Belonging to a community promotes mental health, social well-being and safety, all of which are linked to crime reduction. • The project should increase employment and stimulate the economy, contributing to improved health.								

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
Landscape								
Change in Topography	C/O/D	A	H	LSA	N/A	LT	C	I
Change in Terrestrial Plant Species	C/O/D	A	H	LSA	N/A	LT	C	I
Change in Hydrological Environment	C/O/D	A	H	LSA	HS	LT	C	I
• Construction and operation of the site will result in ongoing and significant changes to the landscape, notably with the expansion of the pits, waste rock pile and tailings facility. These changes will alter the visual landmarks of the area, creating new artificial plateaus up to 499.76 m in altitude. • Impacts will be visible mainly in the Local Study Area (LSA) and will be irreversible, extending over the long term, preventing a return to initial conditions. • The loss of natural environments and the potential introduction of invasive exotic species will lead to a reduction in plant diversity. • Natural landscape units will be most affected, especially during construction. Progressive restoration is planned during and after operation, but a complete return to the original state will be partially impossible. • Bibou Creek diversion and flooding the pits will alter the water regime, affecting wetlands (particularly peatland). • This could reduce biological diversity, encourage invasive species and disrupt soil balance (erosion, loss of nutrients).								
• Even after closure and reclamation, persistent hydrological impacts will remain, particularly on water flow regulation. • The impacts of the project will be extending over the long-term, high in magnitude, mainly limited to the LSA. • Cree users will see their perception of the area transformed, through the loss of visual landmarks, viewing angles and land morphology. • Progressive rehabilitation of vegetation and hydrological functions will partially mitigate impacts, but a complete return to original natural conditions will not be possible.								
Rights and Interests of the Cree								
Changes in rights and interests	C/O/D	A	NMC	RSA	NS	LT	C	R
Change in land and resource use	C/O/D	A	M	LSA	MS to HS	LT	C	R
Changes in social and economic conditions	C/O/D	P/A	H/M	LSA/RSA	NS	ST/MT	C	R
Changes in sanitary conditions	C/O/D	P/A	L/M	LSA/RSA	NS	ST/MT	IR/R	R

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility
• Residual adverse impacts on Cree rights and interests will be negligible in magnitude and limited to the RSA, continuous, reversible and extending over the long-term. • Troilus is committed to ongoing engagement with the Cree communities to better understand and mitigate the impacts of the project on their rights and interests, and to integrate them into project decisions, notably through the development of master plans and compensation measures. • The company aims to build a long-term relationship with the communities of Mistissini and Oujé-Bougoumou, taking into account traditional practices to support the participation of indigenous employees. • The project will result in the loss of harvesting sites in the PDA and a reduction in harvesting success in the LSA, due to the clearing, construction and relocation of infrastructure. • Disturbances related to blasting, transportation, workforce presence and mining activities will disrupt Cree land and resource use and also recreational activities, although these impacts are mostly temporary and reversible. • Some areas may be temporarily restricted, and modifications to aquatic environments could affect navigation, fishing and hunting. • Despite mitigation measures, impacts on Land and resource use will remain adverse, of moderate magnitude, continuous over the long-term, but reversible. • The project will generate several thousand direct, indirect and induced jobs during the construction and operation phases, helping to reduce unemployment and develop local skills.								
• It will stimulate the regional economy and indigenous businesses through procurement contracts and investments estimated at over $12 billion. • Household incomes will rise, and inclusion measures will aim to encourage the participation of under-represented groups, including First Nations people. • Despite anticipated job losses at closure, the overall residual economic impact will remain positive and substantial during the active project period. • The project will put pressure on local human resources, leading to increased competition for labour and higher wages. • This could adversely affect staff retention for local businesses. • - At closure, the loss of direct and indirect jobs will cause a significant drop in revenues, representing an irreversible impact. • Economic spin-offs may not be equitably distributed, which could accentuate inequalities, particularly towards Indigenous communities. • Changes in Land and resource use could adversely affect food security and the sense of belonging of Indigenous communities. Measures are planned, such as adapting work schedules and promoting cultural participation. • Although environmental impacts on soil, water and food are considered limited, concerns persist regarding mercury contamination of fish, justifying the implementation of monitoring programs. • - Due to anticipated exceedances of NO_2 and PM2.5 thresholds, particularly at the workers' camp, dust and air quality management plans will be implemented. • Living conditions in the camps, which are well supervised, could however generate psychosocial stress. Measures are planned, such as an employee assistance program and the presence of nursing staff. • Overall, residual impacts on health are considered low to moderate, temporary, extending over local to regional area, and reversible thanks to the mitigation measures, environmental monitoring and support mechanisms put in place.								

Summary of Residual Impacts

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic extent	Timing	Duration	Frequency	Reversibility

KEY
See Chapter 6 for detailed definitions

Project phase:
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse

Magnitude:
NMC: No Measurable Change
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LSA: Local Study Area
RSA: Regional Study Area
M: Worldwide

Timing:
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long term
N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible