Appendix C.6

Greenhouse Gases Following the Strategic Assessment of Climate Change

Crawford Nickel Project Technical Data Report - Greenhouse Gases following the Strategic Assessment of Climate Change

September 30, 2024

Prepared for:

Canada Nickel Company

Prepared by:

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Limitations and Sign-off

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Executive Summary

The Canada Nickel Company Incorporated (Canada Nickel) proposes to develop, construct, operate, and progressively reclaim a new Open Pit nickel mine and processing facility, collectively known as the Project (the Project), approximately 42 km north of Timmins, Ontario. The Project includes the development of an Open Pit, stockpiles, two ore processing plants, and other mine related infrastructure, as well as a new rail spur line. Highway 655 and an existing 500 kilovolt (kV) transmission line will be relocated to facilitate the Project. The Project has an expected project life of 41 years.

The following Greenhouse Gas Assessment consolidates the results of the assessment of the effects of each of the Project components and physical activities, in all phases of the Project, based upon a comparison of baseline environmental, health, social and economic conditions and the predicted future conditions with and without the Project for Greenhouse Gases (GHG). The Greenhouse Gas Assessment will inform the completion of the associated Valued Component chapter and will be appended to the Impact Statement.

This Greenhouse Gas Assessment has been prepared pursuant to the *Impact Assessment Act, 2019* and in consideration of the Tailored Impact Statement Guidelines (TIS Guidelines) for the Project.

The Strategic Assessment of Climate Change (ECCC 2020) was used as guidance to assess the effect to Climate Change in this Greenhouse Gas Assessment, the assessment includes quantifying GHG emissions, carbon sinks, evaluating the impact of the Project on federal emissions reduction efforts and on global GHG emissions and identifying mitigations for climate change and greenhouse gas emissions, including a Best Available Technology/Best Environmental Practice (BAT/BEP) assessment and a net-zero GHG emissions plan.

Based on Project technical feasibility studies, prior to the conducted BAT/BEP assessment the preliminary Project net GHG emissions over the Project lifetime are estimated to be approximately 15,199 kt CO_2e and the average Project GHG emissions intensity throughout operations is estimated to be 3.05 kt CO_2e/t Ni Eq. These preliminary estimates include the implementation of trolley-assist haulage and grid electricity as the Project's primary energy source, which were identified as best available technologies during BAT/BEP assessment. If the additional technologies of battery electric mining vehicles and autonomous vehicles determined to be technically and economically feasible and result in GHG emission reductions, according to BAT/BEP assessment, are implemented according to the Project's proposed net-zero plan, Project net GHG emissions can be reduced to approximately 11,433 kt CO_2e, prior to the use of offsets, and the average Project GHG emissions intensity can be reduced to approximately 1.47 kt CO_2e/t Ni Eq.

As part of Canada's 2030 emissions reduction plan, Canada has set a 2030 emissions reduction target of 40% below 2005 levels (ECCC 2022). This target represents approximately 443 Megatonnes CO_2e emissions Canada-wide in the year 2030. In the year 2030, with the implementation of the Project's net-zero plan, it is estimated that net annual GHG emissions from the Project would amount to 154 kt CO_2e, approximately 0.03% of Canada's 2030 emissions reduction target.

Canada's ultimate GHG target is to achieve net-zero emissions by 2050 (ECCC 2022). With the implementation of the Project's net-zero plan, it is estimated that in 2050, the Project's GHG emissions will amount to approximately 24 kt CO_2e. As part of the net-zero plan, carbon offsets will be purchased to offset remaining residual emissions post 2050, such that the Project is net-zero emissions, in alignment with Canada's target.

In addition to the net-zero plan, Canada Nickel intends to implement an In Process Tailings (IPT) carbonation active CO_2 sequestration process, assuming sequestered CO_2 will be sourced from regulated industrial emitters who will count the associated GHG reduction against their net facility emissions. With the IPT Carbonation process implemented, given an estimated average life of mine sequestration capacity of 1.3 Megatonnes CO_2 per annum, the Project would be expected to provide a carbon storage capacity of approximately 54 Megatonnes CO_2 over the life of the Project. This added CO_2 storage capacity within Canada as a direct result of the Project proceeding may provide an opportunity for the Project to promote emissions reductions from other regulated emitters and have an overall positive impact on Canada-wide GHG emissions reduction targets.

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Acronyms and Abbreviations

AHS	Autonomous Haulage System
AHT	Autonomous Haul Trucks
BAT	Best Available Technology
BAU	business as usual
BEP	Best Environmental Practice
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
DAC	direct air capture
DOM	dead organic matter
ECCC	Environment and Climate Change Canada
GHG	greenhouse gas
GWP	global warming potential
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPT	In Process Tailings
kWp	kilowatts peak
LNG	liquefied natural gas
LSA	Local Study Area

MTO	Ministry of Transportation
N_2O	nitrous oxide
Ni	nickel
Ni Eq	nickel equivalent
NIR	National Inventory Report
ONR	Ontario Northland Railway
PA	Project Area
SACC	Strategic Assessment of Climate Change
t CO_2e/y	tonnes of carbon dioxide equivalent per year
TMF	Tailings Management Facility
tpd	tonnes per day

Glossary of Technical Terms

Carbon dioxide equivalent (CO_2e)	The CO_2e emissions are obtained by multiplying the emissions of a GHG by its global warming potential (GWP) for a given time horizon. CO_2e is a metric to describe the combined effect that GHGs have on the atmosphere.
Global warming potential (GWP)	A measure of how much heat a greenhouse gas traps in the atmosphere relative to CO_2.
Greenhouse gas (GHG)	A GHG is defined as any gas in the atmosphere that absorbs and re-emits infrared radiation.
Net-zero	The concept that the emissions being emitted are offset by emission reductions elsewhere (definition applied by Strategic Assessment of Climate Change, ECCC 2020).
Scope 1 emissions	Direct GHG emissions that occur from sources that are owned or controlled by the Project (e.g., emissions from mining fleet).
Scope 2 emissions	Indirect GHG emissions associated with the generation of acquired energy from sources that are not owned or controlled by the Project (e.g., emissions in Ontario from electricity generation).
Scope 3 emissions	Emissions that are not produced by the Project itself and are not the result of activities from assets owned or controlled by the Project, but by which the Project is indirectly responsible for up and down its value chain. (e.g., fuel transport to site).

1 Introduction

Canada Nickel Company (Canada Nickel) proposes to develop, operate, and progressively reclaim the Project (the "Project"), a new Open Pit nickel mine and processing facility approximately 42 kilometres (km) north of Timmins, Ontario along Highway 655. The Project is being assessed in accordance with the *Impact Assessment Act*, *2019*.

Stantec Consulting Ltd. (Stantec) has been retained by Canada Nickel to conduct an assessment of greenhouse gases (GHG) for the Project. This report provides a GHG assessment based on the proposed Project design and corresponding activities proposed during construction, operations, and decommissioning of the Project.

As per the Tailored Impact Statement Guidelines: Project (Impact Assessment Agency of Canada, 2023) (TIS Guidelines), this Greenhouse Gas Assessment provides information to satisfy the requirements of Environment and Climate Change Canada's (ECCC) Strategic Assessment of Climate Change (ECCC 2020) herein referred to as the SACC, and the associated Draft Technical Guide Related to the SACC (the draft Technical Guide, ECCC 2021a). As per the TIS Guidelines, the assessment of the effect to Climate Change is intended to include GHG emissions, carbon sinks, the impact of the Project on federal emissions reduction efforts and on global GHG emissions and mitigations for climate change and GHG emissions.

The information presented in this Greenhouse Gas Assessment and used to quantify GHG emissions resulting from the Project have been obtained from Canada Nickel, existing literature, published technical data sources, engineering calculations, or from previous similar project experience.

1.1 Study Objectives

The Crawford Nickel Project Technical Data Report - Greenhouse Gases following the Strategic Assessment of Climate Change will inform the Impact Statement for the Project. The objectives of this study are to describe and present available information on the expected GHG emissions of the Project within the study area.

The scope of the Crawford Nickel Project Technical Data Report - Greenhouse Gases following the Strategic Assessment of Climate Change includes the following information, presented in alignment with the requirements of the SACC (ECCC 2020), Section 5 – Climate Change Information in The Impact Statement Phase:

- GHG Emissions
  - Description of the Project's main sources of GHG emissions (Section 4.1) and their estimated annual emissions over the project lifetime (Appendix C)
  - Net GHG emissions by year for each phase of the project (Section 4.5)

  - Each term of Equation 12 per year, for each phase of the project (Equation 1 from the Strategic Assessment of Climate Change, October 2020) (ECCC 2020) (Section 4.5)
  - Emission intensity for each year of the operations phase of the project (Section 4.6)
  - The quantity and a description of the "units produced" used in Equation 13 for each year of the operations phase of the project (Equation 2 from the Strategic Assessment of Climate Change, October 2020) (ECCC 2020) (Section 4.6.1)
  - Methodology, data, emission factors and assumptions used to quantify each element of the net GHG emissions (Section 4.2)
  - A discussion on the development of emissions estimates and uncertainty assessment (Section 4.3)
  - description of large sources of GHG emissions that may be the consequence of accidents or malfunctions (Section 4.4)
- Impact of the Project on Carbon Sinks
  - A description of project activities in relation to significant landscape features and regionally dominant ecosystems (Section 5.1)
  - Land areas directly impacted by the project, by ecosystem type (Section 5.1)
  - Initial Carbon Stocks in living biomass, dead biomass and soils by ecosystem type on land impacted by the Project (Appendix C)
  - Fate of carbon stocks on directly impacted land by ecosystem type (Section 4.2.1.2)
  - Anticipated land cover on the impacted land areas after the Project is in place (Section 4.1.1.5)
- Impact of the Project on federal emissions reduction efforts and on global GHG emissions (Section 10)
- GHG Mitigation Measures
  - Best Available Technology/Best Environmental Practice (BAT/BEP) Determination to identify ways to minimize the project's GHG emissions (Section 6.1)
  - A description of any additional mitigation measures (such as direct air capture technology and afforestation) that will be taken to mitigate remaining GHG emissions, if applicable
  - A description of any offset credits that have been or will be obtained to mitigate remaining GHG emissions (Section 9.1.3)
  - A description of measures taken to mitigate the Project's impact on carbon sinks, including measures to restore disturbed carbon sinks (Section 6.1.6.3)
  - Subject to public availability of information, a comparison of the Project's projected GHG emission intensity to the emission intensity of similar high-performing, energy efficient Project types in Canada and internationally (Section 6.1.7)

  - A list of the federal, provincial or territorial GHG legislation, policies or regulations that will apply to the Project (Section 9.6)
- Net-zero Plan
  - Summary of credible net-zero plan and estimated net GHG emissions for each Project phase, indicating 0 net GHG emissions by 2050 (Section 9)
- Appendix B
  - Source data provided by Canada Nickel to Stantec and used in this Greenhouse Gas Assessment
- Appendix C
  - GHG emission inventory calculations

1.2 Project Overview

Canada Nickel proposes to develop, construct, operate, and progressively reclaim a new Open Pit nickel mine and processing facility, collectively known as the Project. The Project includes the development of an Open Pit, stockpiles, ore processing plants, and other mine related infrastructure, as well as a new rail spur line and the relocation of Highway 655 and existing 500 kilovolt (kV) transmission line. Ore will be extracted from a single Open Pit that will be divided into an east zone and main zone. The Project has a mineral reserve estimate of 1,715 million tonnes (Mt) and an expected Project life of 41 years.

The Project is located approximately 42 km north of the City of Timmins, Ontario, in the geographic townships of Crawford, Carnegie, Kidd, Lucas, Beck, Nesbitt, Wark, and Prosser (Figure A.1). A small portion of the Project extent within the geographic townships of Kidd and Wark also lies within the municipal boundary of the City of Timmins. The site is accessible year-round by Highway 655, with supplies available in Timmins, Cochrane, Iroquois Falls and Smooth Rock Falls. A 25 km rail line is proposed to be constructed to connect the Project to the nearest rail network, to allow transport of freight to and from the Project.

A 230 kV electricity transmission line running from the Porcupine substation near Timmins to the Project will be installed to deliver power for the Project. Diesel-fired generation may be used during the construction and decommissioning phase of the Project, however there is no anticipated use of diesel generators as a material power source once grid power is available.

Based on the current Project design, the maximum rate of ore extraction will be up to 240,000 tonnes per day (tpd), with an estimated average rate of 160,000 tpd over the life of mine. The two ore processing plants and associated service facilities will process run of mine ore delivered to primary crushers to produce nickel concentrate, iron concentrate, and tailings at a rate of approximately 60,000 tpd at the start of mine life, ramping up to a maximum of 120,000 tpd. In addition to nickel and iron, other metals such as cobalt, chromium, palladium and platinum are expected to be recovered from two concentrate streams.

Based on the proposed processing rate and current information regarding the ore body, the current life of the proposed Project is expected to be approximately 41 years. Mining would be completed at a faster pace than milling, thus mining of ore would occur for about 30 years, then milling alone for the last 11 years.

Concentrate from the processing plants will be loaded onto rail cars and shipped via the rail spur line for further processing offsite.

The Project aims to leverage its advantageous position in the Timmins-Cochrane mining camp to become a leading producer of critical minerals intended for use in meeting global demand from the stainless steel and lithium-ion battery markets and for helping move toward the decarbonization of the global transportation economy. The Project has the potential to strengthen Canada's economy through job creation and positive economic impact, while advancing global climate change efforts.

1.3 Key Project Activities

The timing of activities and installation of Project components will occur in sequence to allow for the efficient extraction of materials. Various construction, operations, and decommissioning activities are proposed throughout the life of the mine. For the purposes of the assessment, these project activities are anticipated to be advanced in three phases:

- Construction (Year -3 to Year -1)
- Operations
  - Operations phase 1 (Year 1 to Year 5): 60 kt/d milling capacity with ore extraction
  - Operations phase 2 (Year 5 to Year 30): 120 kt/d milling capacity with ore extraction
  - Operations phase 3 (Year 30 to Year 41): 120 kt/d milling capacity with no ore extraction
- Decommissioning and closure
  - Active closure (Year 41 to Year 46)
  - Passive closure (Year 46+)

GHG emissions are assessed on an annual basis for each temporal phase of the Project.

1.3.1 Construction Phase

The Construction Phase will include the preparation of the site up to the point at which the first process plant has been commissioned and is ready to commence operations. This phase will include site preparation, physical construction, pre-production, and commissioning activities. Construction is anticipated to begin in the Main Zone and East Zone, and rock extracted at this time may be crushed into aggregate using a mobile aggregate crusher for use during the construction of roads and other infrastructure, as necessary.

It is noted that additional construction will occur through the operations phase of the Project, and that this phase is defined by the start of ore processing.

1.3.2 Operations Phase

The operations phase is focused on the active processing of ore and generation of concentrates for delivery to market, specifically operation of the process plant(s). Due to the sequential nature of the mine operations, the operations phase of the Project has been divided into 3 sub-phases based on the Open Pit extraction schedule and sequential operation of the two process plants.

The three sub-phases of the operations phase include:

- Operations phase 1 **–** This phase includes the operation of the first of two process plants that will be operating at an ore processing capacity of approximately 60 kt/day (or 21.9Mt/a). IPT carbonation within the process plant may also commence if a CO_2 source is available. Mining operations during this phase will produce more ore than the process plant's rated throughput, with surplus material to be stockpiled in the East Stockpile location for future processing. Construction will continue during the phase to expand and construct the second process plant and other supporting mine infrastructure, including the Highway 655 realignment. Material will begin to be stored within the West Stockpile at the end of this phase
- Operations phase 2 **–** This phase includes the operation of both process plants that will be operating at an ore processing capacity of approximately 120kt/d (or 43.8 Mt/a), including IPT carbonation. Mining operations during this phase will produce up to 240 kt/day, which is more ore than the process plants can process. Surplus ore will continue to be stockpiled in the East and/or the West Ore Stockpiles
- Operations phase 3 **–** This phase includes continuation of the operation of both process plants at an ore processing capacity of approximately 120kt/d (or 43.8 Mt/a) following completion of mining operations (e.g., no further extraction of ore from the pits). The process plants, including IPT carbonation, will continue to operate by processing the ore stockpiled during Operations Phase 1 and 2. As mine operations cease, there will be an opportunity for progressive reclamation of the pits, haul routes, and other no longer used areas of the Project site

1.3.3 Decommissioning and Closure Phase

Following the completion of ore processing, all Project operations will cease, and active closure will commence. Active closure includes the removal of buildings, structures, and other infrastructure, as well as reclamation and site stabilization activities. Once complete, the Project will then enter a passive closure phase as the pit lake fills. During this time, closure monitoring and adaptive mitigation will occur. Following pit lake filling, the Project site will be permanently closed.

Activities completed during the decommissioning and closure phase of the Project are focused on reclaiming the environments, establishing physical, chemical, and biological stability at the site, and to meet desired end land functions and uses. The Closure Plan will be updated throughout the life of the Project as necessary to reflect the environmental requirements in place at the time of closure. The Closure Plan will be prepared, refined, and implemented in accordance with the Ontario *Mining Act* and Ontario Regulation 35/24.

Progressive reclamation throughout the course of the mine life will occur, but the majority of the closure activities will commence at the cessation of mining activities and will be completed five years after ore processing ceases. Ongoing closure monitoring and maintenance activities will be carried out throughout active and passive closure phases until the closure objectives have been satisfied and the Project has been moved to a closed out and abandoned status.

1.3.4 Ancillary Facilities and Infrastructure Outside Care and Control of Canada Nickel

There are several components and activities that are ancillary to the Project and are outside of the operational care and control of Canada Nickel. These ancillary components will be built and/or operated by others but are included in the activities considered in the assessment of effects since they are required for the operation of the mine. These ancillary components include:

- Rail spur line connecting the process plant to the existing Ontario Northland Railway spur line at the Kidd Mine
- Relocated section of a 500 kV transmission line that is owned, operated, and maintained by Hydro One
- Realigned segment of Highway 655 owned, operated and maintained by Ministry of Transportation (MTO)

Additional details and information on each of these ancillary facilities and infrastructure is provided in Chapter 3 of the Impact Statement.

GHG emissions associated with the realignment of Highway 655 are included as a direct GHG emissions source in the net GHG emissions of the Project, as Canada Nickel will be responsible for the design and construction of the realignment, including any temporary by-passes, and will transfer the ownership of the highway to MTO once construction is complete (Impact Statement, Chapter 3 – Project Description). GHG emissions associated with the construction of the relocated 500 kV transmission line and rail spur, as well as operational emissions associated with shipping of product concentrate by rail, are quantified as ancillary GHG impacts of the Project and not included in net Project GHG emissions and the net-zero plan as they are anticipated to fall outside the operational and economic control of Canada Nickel.

1.4 Study Area

The **Project Area (PA)** encompasses the Project footprint and is the anticipated area of physical disturbance associated with the construction, operations and decommissioning/closure of the Project. The

PA is 11,785 hectares (ha) (118 square kilometres [km^2]) and includes, but is not limited to, the Open Pit, stockpiles, ore-processing components, tailings management facility, water management facilities and drainage works, mining infrastructure, site access and internal roads, power supply and distribution, and waste management. The extent of the PA for the Project is shown in Appendix A, Figure A.2.

The **Local Study Area (LSA)** encompasses the area in which Project-related effects (direct or indirect) were predicted or measured with a level of confidence appropriate for the assessment and in which there is a reasonable expectation that the potential effects in the LSA are of public interest.

The **Regional Study Area (RSA)** includes the area within which cumulative effects on the Valued Component are likely to occur, depending on the location of other past, present or reasonably foreseeable future projects or activities.

No LSA or RSA have been established for the assessment of GHGs for the Project, as the environmental effects associated with GHG emissions are a global phenomenon. This is based on GHGs mixing well and remaining in the atmosphere for some time dispersing well away from their emission sources (i.e., effects are not localized) (Intergovernmental Panel on Climate Change [IPCC] 2013). The following assessment considers the quantity of GHGs released during construction, operations activities and decommissioning of the Project.

2 Regulatory Setting

This Greenhouse Gas Assessment has been prepared pursuant to the *Impact Assessment Act, 2019* and in consideration of the TIS Guidelines: Project (Impact Assessment Agency of Canada, 2023). In accordance with the TIS Guidelines, this Greenhouse Gas Assessment follows the methodology and requirements of the SACC.

3 Background

The environmental effects associated with GHG emissions are a global phenomenon, effects are not localized, and there are no existing material sources of GHG emissions identified in the PA, therefore no baseline report on the existing conditions of the PA has been prepared in Chapter 9 of the Impact Statement. This Greenhouse Gas Assessment considers the quantity of GHGs released during construction, operations activities and decommissioning of the Project, including the assessment of foregone carbon sinks from removal of existing biomass in the PA (Section 5 – Carbon Sinks).

4 Project GHG Emissions

A GHG can be any gas in the atmosphere that absorbs and re-emits infrared radiation, thereby acting as a thermal blanket for the planet that warms the lower levels of the atmosphere. GHGs can be released from both natural and anthropogenic (human activity) sources (IPCC 2013).

GHGs are estimated provincially and federally in Canada and are reported annually in the National Inventory Report (NIR) published by ECCC. The most recently available NIR includes the following GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) (ECCC 2023b). This assessment of the Project considers the same set of GHGs as the NIR.

For this assessment, the GHGs that may be released during Project activities include mainly CO_2, CH_4, and N_2O. The GHGs that are not expected to be emitted by the Project in substantive quantities are PFC, HFC, SF_6, and NF_3, as these gases are not known to be required for Project activities, therefore, they are excluded from further consideration in this assessment.

The emissions of each of the included GHGs are multiplied by their 100-year global warming potential (GWP) as determined by the IPCC and are reported as carbon dioxide equivalent (CO_2e) in tonnes (t CO_2e). The GWP used in this assessment of GHGs align with the IPCC Fifth Assessment Report (IPCC, 2013):

- CO_2 = 1
- CH_4 = 28
- N_2O = 265

The total mass of CO_2e for the Project is calculated using Equation 1.

Equation 1

$$CO_2e = (mass\ CO_2 * 1) + (mass\ CH_4 * 28) + (mass\ N_20 * 265)$$

4.1 Emission Sources

GHG emissions quantified for this Greenhouse Gas Assessment include Scope 1 and Scope 2 sources during the construction, operations and decommissioning phases of the project as well as some other indirect emissions from ancillary infrastructure. Scope 1 and Scope 2 emissions under the operational control of Canada Nickel have been included in the calculation of net emissions, while other indirect emissions have been quantified as an emissions source but have not been included in the calculation of net emissions and the net zero plan as they are expected to fall outside of Canada Nickel operational control. The following subsections categorize each emission source type and the associated quantified emissions.

4.1.1 Scope 1 Direct Emission Sources

4.1.1.1 Stationary Combustion

The Project does not have any material sources of stationary combustion based on the current energy plan provided by Canada Nickel. Electrical power will be obtained from the Ontario power grid. Diesel-fired generation may be used during the construction and decommissioning phase of the Project, however there is no anticipated use of diesel generators as a material power source once grid power is available. Data on the use of diesel generators is not currently available, however this is not expected to contribute to greater than 1% or more of the total direct GHG emissions of the Project, the SACC Technical Guidance (ECCC 2021a) criteria for emissions sources requiring estimation. Emissions associated with diesel generators have thus not been quantified in the net Project GHG emissions.

4.1.1.2 Mobile Diesel Combustion

Mining equipment and vehicles are the largest source of Scope 1 GHG emissions associated with the Project. A list of the mining equipment and associated annual fuel volume, prepared by Canada Nickel for the Mining Feasibility Study (Ausenco, 2023) and used as the basis for fuel consumption in this GHG emissions assessment are provided in Appendix B. Estimated annual GHG emissions from diesel combustion in the mobile fleet of mining equipment and vehicles are provided alongside annual emissions of other direct and indirect sources in Appendix C.

4.1.1.3 Mobile Gasoline Combustion

Gasoline will be used by light-duty fleet vehicles and for gasoline lighting plants (portable gasoline generators that have mounted lighting towers to provide portable site lighting where and when required). Gasoline use is expected to be minor relative to diesel use for heavy-duty mining equipment, with the total gasoline fuel requirement for the Project estimated to represent just 2.8% of the total diesel fuel requirement. A list of the gasoline light-duty vehicles and associated annual fuel volume, prepared by Canada Nickel for the Mining Feasibility Study (Ausenco 2023) and used as the basis for fuel consumption in this GHG emissions assessment are provided in Appendix B. Estimated annual GHG emissions from gasoline combustion in the light-duty vehicle fleet are provided alongside annual emissions of other direct and indirect sources in Appendix C.

4.1.1.4 Blasting

Blasting activities for the Open Pit mine will result in GHG emissions from the fuel used within the explosives material. A summary of blasting activity data, prepared by Canada Nickel for the Mining Feasibility Study (Ausenco 2023) and used as the basis for calculating blasting GHG emissions in this assessment are provided in Appendix B. Estimated annual GHG emissions from blasting are provided alongside annual emissions of other direct and indirect sources in Appendix C.

4.1.1.5 Land-Use Change

The Project footprint covers a total area of 11,785 hectares, that for the purpose of the current GHG assessment is estimated to be approximately 95% forest land (11,196 hectares) and 5% wetland (589 hectares). Although the Project area has significant wetland area in reality, based on the guidance from the SACC Technical Guide (ECCC 2021a), Canada's NIR definition of forest land was used to determine forest land area for the GHG assessment, which states that Forest lands in Canada include all treed areas of one hectare or more, with a minimum tree cover of 25% and trees of 5 meters in height, or having the potential to reach this height (ECCC 2023b). As such, tree covered wetland areas were treated as forest area during the GHG assessment, resulting in the high percentage of total land area consisting of forest lands.

Of the total Project area approximately 53% of the land area is expected to be converted to settlement land-use as a direct result of the Project (6,259) hectares, which includes conversion of land area required for mining operations, the Open Pit, all other associated mining infrastructure and waterbodies. GHG emissions resulting from the land-use change are provided alongside annual emissions of other direct and indirect sources in Appendix C.

4.1.1.6 Ancillary Infrastructure - Highway Realignment

To facilitate extraction from the Main Zone of the Open Pit mine, approximately 26 km of Highway 655 will be realigned to the west of the mine to divert traffic around the mine site. Canada Nickel will be responsible for the design and construction of the realignment, including any temporary bypasses, and will transfer ownership of the highway to MTO once construction is complete (Impact Statement, Chapter 3 – Project Description). The realigned highway infrastructure and corresponding construction activities are included as a Canada Nickel owned direct GHG emission source of the Project. GHG emissions associated with the operation of the highway post MTO transfer are not quantified as these emissions are outside the control of Canada Nickel.

4.1.1.7 Ancillary Infrastructure – Rail Spur Construction

A new 25 km rail spur will be constructed by Canada Nickel to facilitate the transport of materials to and from the Project site. Following construction, ownership of the spur line will be transferred to Ontario Northland Railway (ONR). The spur line will run from the process plant in a southerly direction to the existing ONR spur line operated by Glencore for its Kidd Operations (Impact Statement, Chapter 3 – Project Description). The construction of the rail spur is included as a Canada Nickel owned direct GHG emission source of the Project.

4.1.1.8 Ancillary Infrastructure – Transmission Line Relocation

Approximately 29 km of an existing 500 kV transmission line owned by Hydro One will be relocated due to bisection of the location of the proposed Open Pit mine. The plan is to relocate the transmission line along a similar corridor as the proposed realignment of Highway 655. As owners of the facility, Hydro One will be completing a Minor Transmission Facility Class Environmental Assessment for the relocation of the transmission line (Impact Statement, Chapter 3 – Project Description). Although the relocation of the electricity transmission line will be fully managed by Hydro One, it has been scoped within the current Project and thus is included as a direct GHG emission source of the Project.

4.1.2 Scope 2 Indirect Emission Sources

4.1.2.1 Acquired Energy – Purchased Grid Electricity

Power to the site will be provided by a 230 kV transmission line to be constructed and operated by a third-party. A summary of electricity usage data by mining activity, prepared by Canada Nickel for the Mining Feasibility Study (Ausenco 2023) and used as the basis for electricity consumption in this GHG emissions assessment is provided in Appendix B. Estimated annual GHG emissions from purchased grid electricity are provided alongside annual emissions of other direct and indirect sources in Appendix C.

4.1.3 Other Indirect Emission Sources

4.1.3.1 Ancillary Infrastructure – Rail Spur Operation

Following construction of the new 25 km rail spur, ownership will be transferred to Ontario Northland Railway (ONR) and transportation of product concentrate will fall under the care and operational control of third parties rather than Canada Nickel.

For the purpose of this assessment, GHG emissions associated with transport of product concentrate are quantified as emissions sources ancillary to the Project, however given that emissions are anticipated to fall outside of Canada Nickel operational control (Impact Statement, Chapter 3 – Project Description) and emissions reductions will be dependent on third-parties, these have been excluded from the estimated net project GHG emissions and net-zero plan.

4.2 Emissions Quantification Methodology

For each emission source category described in Section 4.1 the GHG emission quantification methodology followed and emission factors used are provided here, along with applicable references.

4.2.1 Scope 1 Direct Emission Sources

4.2.1.1 Combustion and Blasting

Direct GHG emissions from the combustion of diesel and gasoline fuels in mobile equipment were quantified using Equation 2, which is from the SACC Technical Guide (2021), Equation 2: Emissions from stationary and mobile combustion.

Equation 2

$$GHG\ Emissions\ from\ Fuel\ Combustion = Estimated\ quantity\ of\ fuel\ to\ be\ combusted\ \times Emission\ factor$$

Direct GHG emissions from blasting were also quantified using Equation 2, where the annual amount of explosives used was multiplied by the applicable emission factor. As per Table 1 of the SACC Technical Guide (2021) emission factors from the combustion of fuels were sourced from the latest NIR (NIR 2023) and emission factors for explosives were provided to Canada Nickel via communications from Dyno Nobel. The emission factors used in the GHG emissions quantification are provided in Appendix C.

4.2.1.2 Land-Use Change

Direct GHG emissions from land-use change were quantified according to the methodology outlined in Annex B of the SACC Technical Guide (2021), which follows the approaches of the latest NIR (NIR 2023) and IPCC guidelines. Land-use change emissions were estimated for three land use changes estimated to occur as a result of the Project; conversion of forest land, conversion of wetland and flooding of land. As per the SACC Technical Guide (2021), because the planned Project site area is greater than 100 ha and majority of the proposed land use represents carbon dense forest land, a Tier 2 approach was used to quantify land-use change emissions, wherein site specific/literature cited biomass and carbon stock factors were used when available, and climate specific default IPCC values otherwise. The emission factors and data sources in the land use GHG emissions quantification are provided in Appendix C. The impacts on carbon stocks of living biomass, dead organic matter (DOM) and soil organic matter from land use conversions, as well as the GHG emissions associated with land flooding were determined as described below.

4.2.1.2.1 Living Biomass

The annual change in converted forest land biomass carbon stock, ΔC_b, was calculated using Equation 3 (IPCC 2006). As per the SACC technical guide (2021) biomass growth on land following conversion, ΔC_g, was assumed 0 and the decrease in biomass from carbon stocks due to losses from harvesting, fuel wood gathering and disturbances additional to land conversion clearing, ΔC_L, was assumed 0 based on Project plans. The change in biomass carbon stock on converted land, $\Delta C_{conversion}$, was calculated using Equation 4 (IPCC 2006), which takes into account the biomass pre and post conversion, B, the area of land converted $\Delta A_{to\ others}$, and the carbon fraction of dry matter, CF.

Equation 3

$$\Delta \boldsymbol{C_b} = \Delta \boldsymbol{C_g} + \Delta \boldsymbol{C_{conversion}} - \Delta \boldsymbol{C_L}$$

Equation 4

$$\Delta C_{conversion} = \sum (B_{after} - B_{Before}) * \Delta A_{to\ others}) * CF$$

4.2.1.2.2 Dead Organic Matter

Annual change in carbon stocks of dead wood and litter (i.e., DOM) due to land conversion, ΔC_{DOM}, was calculated using Equation 5 (IPCC 2006), where C_o represents DOM carbon stock pre conversion, C_n the DOM carbon stock post conversion, A_{on} the area undergoing conversion and T_{on} the time period of transition from old to new land-use category. Based on the recommendations of the SACC Technical Guide (2021), the DOM carbon stock post conversion was considered 0, assuming complete removal of DOM on converted land area with aboveground biomass clearing.

Equation 5

$$\Delta C_{DOM} = \frac{(C_n - C_O) * A_{on}}{T_{on}}$$

4.2.1.2.3 Soil Organic Matter

The annual change in carbon stocks in soils, ΔC_{soils}, was calculated using Equation 6 (IPCC 2006), where $\Delta C_{mineral}$ represents the change in disturbed mineral soil organic carbon stock, $L_{organic}$ represents the annual loss of carbon from drained organic soils and $\Delta C_{inorganic}$ represents the change in inorganic carbon stocks from soil disturbances.

Equation 6

$$\Delta C_{Soils} = \Delta C_{mineral} - L_{organic} + \Delta C_{inorganic}$$

To calculate the change in mineral soil carbon stock due to disturbance, $\Delta C_{mineral}$, Equation 7 (IPCC 2006) was used where SOC_O and SOC_{O-T} represent the estimated soil organic carbon stock at the last year of the inventory and beginning of the inventory respectively, and D represents the time dependence of the stock change factors. The annual carbon loss from disturbed organic soils, $L_{organic}$, was calculated via Equation 8 (IPCC 2006) where A represents the land area of disturbed drained organic soils and EF represents the climate specific emission factor.

Equation 7

$$\Delta C_{mineral} = \frac{SOC_o - SOC_{O-T}}{D}$$

Equation 8

$$L_{organic} = A * EF$$

4.2.1.2.4 Flooded Land

As per the SACC Technical Guide (2021), CH_4 emissions from flooded land from non-reservoirs (i.e., ponds and ditches) were calculated using Equation 9 (IPCC 2019),where i represents the number of waterbodies, j the number of climate zones, w the waterbody class (i.e., pond or canal/ditch), A the total area of the waterbody, EF_{CH4} the CH_4 emission factor and α the trophic state adjustment factor, assumed 1 for a Tier 2 approach.

Equation 9

$$F_{CH_4,other} = \sum_{j=1}^{6}\sum_{w=1}^{3}\sum_{i=1}^{nother_{w,j}} (A_{w,i} * EF_{CH_4,w} * \alpha_{j,w,i})$$

4.2.1.3 Highway Realignment

GHG emissions associated with realignment of Highway 655 were quantified using Equation 10, where D is representative of the length of highway being realigned and EF represents the emission factor for roadway realignment in t CO_2e/km-roadway. Activity data (i.e., length of infrastructure) from the Crawford Nickel Sulphide Technical Feasibility Study (Ausenco 2023) was used to quantify GHG emissions for the Highway 655 relocation. Emission factors for the Highway 655 realignment were obtained via the U.S. Department of Transportation Infrastructure Carbon Estimator (ICE) version 2.1.3 (US DOT 2021). The specific emission factors and data sources used in the calculation of emissions from highway realignment are provided in Appendix C.

4.2.1.4 Rail Spur Construction

GHG emissions associated with construction of the proposed rail spur servicing the Project site were quantified using Equation 10, where D represents track distance of the rail line and EF is the rail construction emission factor in t CO_2e/km-rail.

Equation 10

$$GHG\ (CO_2e) = D * EF_{CO2e}$$

Activity data (i.e., length of infrastructure) from the Project Sulphide Technical Feasibility Study (Ausenco 2023) was used to quantify GHG emissions for the rail spur construction. Emission factors for the rail spur construction were obtained via the U.S. Department of Transportation Infrastructure Carbon Estimator (ICE) version 2.1.3 (US DOT 2021).

4.2.1.5 Transmission Line Relocation

GHG emissions associated with realignment of the 500 kV transmission line were quantified using Equation 10, where D is representative of the transmission line length and EF represents the transmission line construction emission factor in t CO_2e/km-transmission line. Activity data (i.e., length of infrastructure) from the Project Sulphide Technical Feasibility Study (Ausenco 2023) was used to quantify

GHG emissions for transmission line realignment. The GHG emissions estimate per km of constructed 500 kV transmission line was collected from literature (Wei et al. 2021) and used to quantify the emissions from realignment of the 500 kV transmission line.

4.2.2 Scope 2 Indirect Emission Sources

4.2.2.1 Acquired Energy – Purchased Grid Electricity GHG Emissions

GHG emissions from acquired energy (purchased electricity) were quantified following Section 2.1.2.1 of the SACC Technical Guide (2021). For quantification of GHG emissions from acquired energy, Project electricity demand for proposed mining equipment and facilities was collected from Project techno-economic feasibility assessments. Electric grid intensity factors for Ontario were obtained from the ECCC Data Catalogue (ECCC 2023a). Electric grid intensity factors were used for the years 2025 to 2050; beyond 2050, the grid intensity factor was held constant at the 2050 predicted value. To account for differences in electricity generation between the provincial average electricity generation mix for Ontario and the electricity generation mix planned to service the Project in Northeastern Ontario, the ECCC Ontario average emission factors were adjusted based on the percent of natural gas based electricity generation in Northeastern Ontario (IESO 2022a) relative to the average percent of natural gas based electricity generation for the province of Ontario (IESO 2022b) as of 2022. Natural gas represents the major direct GHG emitting electricity generation activity for the Province of Ontario with the rest of electricity generation capacity represented by solar, wind, hydroelectric and nuclear, and a minor amount of biofuel generation (i.e., less than 1%). The electricity consumption demand and projected electricity grid emission factor by Project year is provided in Appendix C.

4.2.3 Other Indirect Emission Sources

4.2.3.1 Rail Spur Operation

Annual GHG emissions associated with operation of the proposed rail spur for shipping of product concentrate were quantified using Equation 11, where D represents tack distance of the rail line and EF's represent rail transport emission factors in t CO_2e/ton-mile.

Equation 11

$$GHG(CO_2e) = D * M_{concentrate} * [EF_{CO2} + (EF_{CH4} * GWP_{CH4}) + (EF_{N2O} * GWP_{N2O})]$$

For quantifying emissions associated with rail transport of product concentrate, activity data (i.e., annual mass of produced concentrate) from techno-economic feasibility studies were used, based on the proposed Project production capacity (Ausenco 2023). Rail shipping emission factors were obtained from the US Environmental Protection Agency (EPA) (US EPA 2023).

4.2.4 Avoided Domestic GHG Emissions

There are no avoided domestic GHG emissions associated with the Project. The annual quantity in Equation 12 below for Net GHG emissions is equal to zero (0).

4.2.5 Offset Measures

As per Section 2.1.4 of the SACC Technical Guide (2021), offset measures include the sum of offset credits, CO_2 captured and stored and corporate-level initiatives. The use of offset credits has been incorporated in the net project GHG emissions of the net-zero plan, to offset residual Project emissions existing following implementation of Best Available Technologies/Best Environmental Practices (BAT/BEP).

4.3 Emissions Uncertainty

4.3.1 Scope 1 Direct Emission Sources

4.3.1.1 Combustion and Blasting

The activity data used to quantify emissions from fuel combustion and blasting is based on estimates from Project feasibility studies. The emission factors used for fuel combustion and blasting are based on fuel and explosive type and available data from sources including Canada's latest NIR (NIR 2023) and Canada Nickel's explosives provider. The emission factors are based on fuel composition and therefore are unlikely to deviate materially year-over-year. Uncertainty in GHG emissions throughout the length of the Project may be decreased by monitoring for changes to preliminary activity data and emission factors for fuel and explosives.

4.3.1.2 Land-use Change

The quantified GHG emissions from land use change have a degree of uncertainty based on the limited availability of Project site-specific carbon stock data at the current time. To minimize uncertainty, a Tier 2 estimation approach using site-specific data was used where data was available via surveys or literature, with a Tier 1 approach using default assumptions from the SACC Technical Guidance (ECCC 2021a) used only where site-specific data was unavailable. Additionally, a conservative quantification approach was applied, wherein in the absence of information, assumptions resulting in greater GHG emissions were prioritized over lower impact assumptions. This is consistent with best practice GHG accounting and can be refined as more site-specific information becomes available.

Additionally, to decrease the uncertainty associated with applied non-site-specific carbon stock and emission factors, region and ecosystem appropriate literature values were used rather than general climate-based IPCC values.

The major assumptions used in the land-use change emissions quantification are provided below:

- The proportion of each land type in converted land area is representative of the breakdown of land type over the total Project site area.
- The proportion of organic vs. mineral soil in disturbed soil is representative of the estimated breakdown of soil type over the total PA.

- Organic carbon in soil decays at a constant rate of 1% per year. Assumption taken from the IPCC guidance for greenhouse gas inventories default decay curve of a 20% decay over a 20-year period (IPCC 2006).
- Carbon stocks in living biomass, DOM and excavated organic soil of converted forest land and wetlands are assumed to be immediately released to atmosphere following conversion.

Additionally, based on the SACC Technical Guide (2021), for the purpose of the net GHG emissions assessment, all removed biomass during land conversion was assumed to release GHG emissions through direct onsite decomposition. As discussed in Section 6 of this report, implementing biomass management practices such as chipping and spreading and/or recovery of merchantable timber would decrease emissions from the quantified base case. Based on current data availability, for the purpose of this report the emissions benefits associated with chipping and spreading and recovery of merchantable timber are discussed qualitatively in the BAT/BEP assessment in Section 6. As more information becomes available on the type of biomass that will be removed, quantitative estimates of the potential GHG reductions associated with these management practices could be developed.

4.3.1.3 Highway Realignment

GHG emissions associated with realignment of Hwy 655 fall under the operational control of the Project and therefore impact Project net GHG emissions. These emissions have been estimated using average emission factors for roadway realignment from the US DOT ICE (US DOT 2021) which has a degree of uncertainty related to the lack of specificity to the Project site. The impact of uncertainty on total Project net GHG emissions however, is not likely to be material, with emissions associated with the realignment of Hwy 655 estimated to represent just 0.03% of total net Project emissions. Furthermore, these emissions will be isolated to the construction phase of the Project and will have no impact on the Project meeting the goals outlined in the net-zero plan in Section 9.

4.3.1.4 Rail Spur Construction and Transmission Line Realignment

There is uncertainty associated with quantified emissions estimates for construction of the rail spur and relocation of the 500 kV electricity transmission line. The magnitude of these construction impacts will largely depend on the fuel/energy source used in construction equipment and the level and type of land clearing/conversion required. As Project specific data is not currently available, emissions estimates using publicly available average emission factors based on infrastructure type have been used. This approach is valuable in providing order of magnitude estimates and was deemed reasonable given that emissions associated with the rail spur construction and transmission line realignment are estimated to represent less than 0.1% of the reported total net Project emissions. Furthermore, these emissions will be isolated to the construction phase of the Project and will have no impact on the Project meeting the goals outlined in the net-zero plan in Section 9.

4.3.2 Scope 2 Indirect Emission Sources

4.3.2.1 Acquired Energy – Purchased Grid Electricity

Emissions from acquired energy were calculated using expected Project electricity demand from preliminary Project feasibility studies and ECCC emission factors (ECCC 2023a). The Project electricity demand is based on estimated electricity use given required construction and operational activities to reach expected production capacity and is expected to deviate following Project commencement. Changes to preliminary electricity use estimates throughout the length of the Project will be monitored in line with the goals of the net zero plan for 2050 and beyond throughout the length of the Project.

The projected Ontario electricity grid emission factors from ECCC are based on numerous simplifying assumptions and carry with them a degree of uncertainty. The ultimate trend of Ontario's electricity grid will depend on numerous socio-economic and technological factors as the province strives to meet growing electricity demand without sacrificing the carbon intensity of the electricity grid. The carbon intensity of the electricity grid is outside the control of Canada Nickel and the degree of decarbonization could change preliminary emission estimates from purchased grid electricity. Future uncertainty in GHG emissions estimates may be decreased by monitoring carbon intensity of the electricity grid. GHG emissions calculations may be refined further through annual calculations based on actual data.

4.3.1 Other Indirect Emission Sources

4.3.1.1 Rail Spur Operation

The emissions estimates for rail transport of Project product concentrate are based on average emission factors from the US EPA for conventional rail shipping (US EPA 2023). The actual emissions from rail transport over the Project lifetime are anticipated to fall under the operational control of third parties rather than Canada Nickel and therefore the extent of GHG emissions and reductions expected over the Project lifetime is uncertain. Conservatively assuming that mitigation measures are not implemented to reduce the US EPA emission factor over the Project lifetime, results in emissions estimates from rail transport of product concentrate that represent less than 0.5% of the estimated net Project GHG emissions. As emissions associated with shipping of product concentrate will be under the care and control of third-parties, these are not included in the net Project GHG emissions under the operational control of Canada Nickel and thus have no impact on the net zero plan outlined in Section 9.

4.4 Unintended Emissions

GHG emissions sources associated with the Project include direct emissions from the combustion of fuels (diesel and gasoline), blasting, acquired energy (purchased electricity), land-use change and highway realignment and indirect emissions from locomotives and other ancillary infrastructure. These sources are not expected to result in a large source of GHG emissions as a consequence of possible accidents or malfunctions, therefore emissions for such scenarios are not applicable or quantified.

4.5 Net Project GHG Emissions

The net GHG emissions were quantified for the Project following Equation 12 (ECCC 2021a). As required by the SACC (2020) and the TIS Guidelines – Project (2023), each term in Equation 12 must be reported separately for each year of the project lifetime, including construction, operations and decommissioning, these are presented in Table 4.1 in units of t CO_2e, with the construction phase representing years 2025-2027, operations representing years 2028-2069 and decommissioning representing years 2070-2072. Based on lack of data currently available for the decommissioning phase, the conservative assumption that decommissioning phase emissions are equivalent to the construction phase emissions has been used, based on the likelihood of the use of similar on-land equipment during the decommissioning phase. In reality these emissions are likely to be lower than assumed.

The net GHG emissions presented in Table 4.1 represent estimated Project GHG emissions under the operational control of Canada Nickel based on Project plans from technical feasibility studies (Ausenco 2023), prior to conducting the required BAT/BEP assessment in Section 6 below. Additional GHG mitigation measures identified during the BAT/BEP assessment are included in the projected net Project GHG emissions provided in Section 9.5 as part of the net-zero plan. Additionally, estimated emissions from locomotives and select ancillary infrastructure outside the care and control of Canada Nickel are reported separately from the GHG emissions in Table 4.1, as it is anticipated that Canada Nickel will have no direct control over reducing these emissions and thus they are not included in the total net GHG emissions in Equation 12 or the proposed net-zero plan.

Equation 12

$$\begin{aligned} Net\ GHG\ Emissions \\ &= Direct\ GHG\ emissions + Acquired\ energy\ GHG\ emissions \\ &- Avoided\ domestic\ GHG\ emissions - Offset\ measures \end{aligned}$$

Table 4.1 Project Net GHG Emissions

Phase	Year	Direct GHG Emissions (t CO_2e/y)	Acquired Energy GHG Emissions (t CO_2e/y)	Avoided Domestic Emissions (t CO_2e/y)	Offset Credits (t CO_2e/y)	Net GHG Emissions t CO_2e/y)
Construction	2025	2,680,872	45			2,680,917
	2026	2,713,502	368			2,713,870
	2027	2,769,019	1,280			2,770,300
Operations	2028	160,619	17,741			178,360
	2029	171,941	19,581			191,522
	2030	150,725	16,762			167,487
	2031	195,827	22,292			218,119
	2032	237,220	28,149			265,369
	2033	282,615	24,554			307,169

Phase	Year	Direct GHG Emissions (t CO_2e/y)	Acquired Energy GHG Emissions (t CO_2e/y)	Avoided Domestic Emissions (t CO_2e/y)	Offset Credits (t CO_2e/y)	Net GHG Emissions t CO_2e/y)
	2034	266,591	19,658			286,249
	2035	285,305	17,496			302,800
	2036	254,942	16,517			271,459
	2037	235,874	16,115			251,989
	2038	252,114	15,048			267,163
	2039	222,503	14,189			236,692
	2040	229,596	13,995			243,591
	2041	202,981	13,354			216,335
	2042	210,393	12,528			222,921
	2043	354,502	11,444			365,947
	2044	227,399	11,130			238,529
	2045	195,935	10,555			206,490
	2046	191,281	9,852			201,133
	2047	164,040	9,200			173,240
	2048	160,722	8,825			169,547
	2049	142,008	9,089			151,097
	2050	151,767	10,067			161,834
	2051	180,517	10,317			190,834
	2052	238,439	10,404			248,843
	2053	181,688	10,134			191,822
	2054	154,125	9,942			164,066
	2055	130,904	9,740			140,644
	2056	189,392	9,119			198,512
	2057	167,320	8,456			175,775
	2058	17,256	8,416			25,672
	2059	14,778	8,408			23,186
	2060	14,853	8,386			23,239
	2061	14,343	8,368			22,711
	2062	16,563	8,354			24,917
	2063	14,043	8,345			22,388
	2064	15,925	8,333			24,259
	2065	16,426	8,325			24,751
	2066	16,386	8,318			24,703
	2067	16,015	8,311			24,326
	2068	16,503	8,305			24,808

Phase	Year	Direct GHG Emissions	Acquired Energy GHG Emissions	Avoided Domestic Emissions	Offset Credits	Net GHG Emissions
		($t\ CO_2e/y$)	($t\ CO_2e/y$)	($t\ CO_2e/y$)	($t\ CO_2e/y$)	$t\ CO_2e/y$)
	2069	2,875	692			3,568
Decommissioning and Closure	2070	12,495	45	-	-	12,540
	2071	45,124	368	-	-	45,493
	2072	100,642	1,280	-	-	101,922
Total		**14,686,905**	**512,201**			**15,199,106**

4.5.1 Other Indirect Emissions – Locomotives and Ancillary Emissions Outside of Canada Nickel Care and Control

Emissions estimates for ancillary sources outside of Canada Nickel operational control are discussed in the following sections.

4.5.1.1 Rail Spur Construction and Operation

The construction of the 25 km rail spur from the existing railway owned by ONR is estimated to result in 19,886 t CO_2e of net GHG emissions during the construction phase of the Project (2025-2027), approximately 0.15% of Project net GHG emissions over the Project lifetime. Shipping of product concentrates via rail is estimated to result in 80,001 t CO_2e net GHG emissions over the Project operational lifetime (2028 – 2069), approximately 0.6% of Project net GHG emissions.

4.5.1.2 Transmission Line Relocation

Relocation of the 500 kV transmission line is estimated to result in 7,105 t CO_2e of net GHG emissions during the construction phase of the Project (2025-2027), approximately 0.05% of Project net GHG emissions over the Project lifetime.

4.6 Project GHG Emissions Intensity

As required by the TIS Guidelines, the emissions intensity for each year of the operations phase of the Project is to be quantified following Equation 2 of the Technical Guide (2021). Equation 2 of the Technical Guide is provided below as Equation 13. The value for each input parameter and the resultant annual Project emission intensity for each year of the operations phase of the Project is provided in Table 4.3.

4.6.1 Units Produced – Payable Nickel Equivalent

The Project is the development of an Open Pit nickel mine and processing facility. From the Project mining activities Canada Nickel will produce Nickel (Ni), Cobalt (Co), Iron (Fe), Chromium (Cr), Palladium (Pd) and Platinum (Pt). Produced quantities of each metal are quantified in units of pounds (lbs), tonnes (t) or ounces (oz) and are converted to a payable nickel equivalent (Ni Eq) which considers both the price and payability of each metal relative to Ni. The Project Sulphide Technical Feasibility Study (Ausenco 2023) outlines the Ni Eq conversion for each metal, which is provided below in Table 4.2.

Table 4.2 Nickel Equivalent (Ni Eq) Conversion

Metal	Unit	Price ($)	Payability (%)	Ni Eq Conversion
Nickel (Ni)	pound	9.53	91	1
Cobalt (Co)	pound	18.14	60	1.3
Iron (Fe)	tonne	325	50	18.7
Chromium (Cr)	pound	1.75	65	0.1
Palladium (Pd)	ounce	1,350	75.2	117.1
Platinum (Pt)	ounce	1,150	76.1	101.0
Reference: Table 15-6 of Ausenco, 2023				

Therefore, the product, or unit produced used to calculate the Project GHG emissions intensity is tonnes of payable nickel equivalent produced (t Ni Eq). The Project GHG emissions intensity calculation was done according to Equation 13. Annual quantities produced of each payable metal as well as the calculated total annual payable Ni Eq quantity were provided by Canda Nickel. The payable metal annual quantities as provided by Canda Nickel for this GHG assessment are included in Appendix B. The preliminary Project GHG Emissions Intensity based on Project feasibility studies and prior to BAT/BEP assessment and implementation is provided in Table 4.3. The emissions intensity is calculated for the operational period of the mine, representing years 2028 through 2069.

Equation 13

$$Project\ Emission\ Intensity = \frac{Net\ GHG\ Emissions}{Units\ Produced}$$

Table 4.3 Project GHG Emissions Intensity

Year	Net GHG Emissions (kt CO_2e)	Units Produced (t Ni Eq)	Project Emission Intensity (kt CO_2e/t Ni Eq)
2028	178,360	27,197	6.56
2029	191,522	33,778	5.67
2030	167,487	38,685	4.33
2031	218,119	51,106	4.27
2032	265,369	70,865	3.74
2033	307,169	74,304	4.13
2034	286,249	59,261	4.83
2035	302,800	67,004	4.52
2036	271,459	74,460	3.65
2037	251,989	60,241	4.18

Year	Net GHG Emissions (kt CO_2e)	Units Produced (t Ni Eq)	Project Emission Intensity (kt CO_2e/t Ni Eq)
2038	267,163	51,865	5.15
2039	236,692	55,329	4.28
2040	243,591	64,997	3.75
2041	216,335	65,413	3.31
2042	222,921	52,922	4.21
2043	365,947	72,996	5.01
2044	238,529	73,813	3.23
2045	206,490	65,754	3.14
2046	201,133	69,043	2.91
2047	173,240	67,601	2.56
2048	169,547	66,499	2.55
2049	151,097	55,482	2.72
2050	161,834	56,575	2.86
2051	190,834	58,232	3.28
2052	248,843	60,523	4.11
2053	191,822	64,277	2.98
2054	164,066	75,907	2.16
2055	140,644	77,720	1.81
2056	198,512	82,550	2.40
2057	175,775	74,673	2.35
2058	25,672	52,439	0.49
2059	23,186	52,439	0.44
2060	23,239	34,065	0.68
2061	22,711	30,012	0.76
2062	24,917	30,012	0.83
2063	22,388	30,012	0.75
2064	24,259	30,012	0.81
2065	24,751	30,012	0.82
2066	24,703	30,012	0.82
2067	24,326	30,012	0.81
2068	24,808	30,012	0.83
2069	3,568	2,215	1.61
Totals (Average Emissions Intensity)	**6,874,065**	**2,250,320**	**3.05**

5 Carbon Sinks

5.1 Project Impact on Carbon Sinks

The Project is expected to result in land disturbance as a result of the land footprint required for infrastructure and pit construction. The land types expected to be impacted by the Project include forest land and wetlands in the Boreal Shield region of Ontario, just north of Timmins.

For the purposes of this assessment, it was assumed that forestland (the predominant land type on site) will contain forest stands within the age range of maximum carbon uptake. This assumption was used to estimate forgone carbon sequestration from forestland cleared for land conversion, with a value of 3.7 used for carbon uptake (NatFlux – Equation 12), representative of boreal mixedwood forests in northern Ontario (NRCAN 2019b). For converted wetlands, which represent a smaller portion of estimated land conversion (i.e., approximately 5%), default IPCC values (ECCC 2021a) by Wetland type were used to estimate the forgone carbon following conversion, based on the expected wetland types undergoing conversion (i.e., bog, fen, marsh and swamp).

To quantify the potential forgone carbon sequestration from impacts on carbon sinks Equation 14 was used for each land use class, I, and disturbance activity, j, as per the SACC Technical Guide (2021), with the conservative assumptions that the post disturbance carbon flux, PostDFlux, is equal 0, the time interval, T, is the default 100 years and the land area, A, is the total land area converted, assuming complete biomass removal. Using Equation 14 the total Project forgone carbon sequestration was estimated to be approximately 7,322,341 t CO_2e.

Equation 14

$$CSI = \sum_{i,j} ((NatFlux - PostDFlux)_{i,j} * T_{i,j} * A_{i,j})$$

Throughout the Project, Canada Nickel will investigate practices to lower GHG emissions on carbon sinks and from land use change relative to the conservative estimates outlined in this report.

5.2 Uncertainty in Carbon Sink Impacts

Limited availability of site-specific data on biomass density required the use of literature values (NRCAN 2019b) for carbon uptake estimates for forestland and SACC Technical Guide (2021) default carbon uptake values for wetlands. Although values specific to the cleared land type and geographic ecosystem were used to reduce uncertainty, there is still uncertainty at the present time as to how well these values reflect the actual Project site and biomass to be cleared. A conservative approach was used to reduce the risk of under quantifying the impact on carbon sinks, assuming that the dominant forest land type is at the age of maximum carbon uptake.

5.3 Additional Carbon Sinks – In Process Tailings Carbonation Process

Canada Nickel plans to implement a novel active carbon sequestration process known as the In Process Tailings (IPT) carbonation process. The IPT Carbonation process aims to accelerate the natural mineral carbonation process through treatment of mine tailings with a concentrated CO_2 source. The process is planned to be implemented at the start of the Project operations and based on preliminary pilot scale feasibility testing (Ausenco 2023) is estimated to have a total average carbon storage capacity of 1.3 Megatonnes per annum, or approximately 54 Megatonnes of CO_2 over the operational life of the Project (Canada Nickel 2024). Additional CO_2 storage capacity in the province of Ontario through technologies such as IPT Carbonation, may motivate further industrial emitters to implement carbon capture technologies to reduce their owned carbon emissions and take advantage of government Carbon Capture, Utilization and Storage (CCUS) incentives, resulting in meaningful emissions reductions across the industrial sector. Preliminary feasibility studies indicate a high demand for CO_2 storage capacity moving toward 2050 with approximately 50 potential industrial emitters concentrated in four distinct clusters in Sudbury, Sault Ste. Marie, Toronto and Sarnia (Ausenco 2023).

6 GHG Mitigation Measures

6.1 Best Available Technology and Best Environmental Practices Determination

The objective of the Best Available Technology and Best Environmental Practices (BAT/BEP) determination is to illustrate how Canada Nickel has considered existing and emerging technologies and practices in the design and planning of the Project.

The process for conducting a BAT/BEP determination follows guidance outlined in the draft Technical Guide related to the SACC (ECCC 2021) and includes:

1. A list of all available and emerging technologies and practices that are relevant to the Project
2. A technical feasibility assessment
3. A GHG reduction potential assessment
4. An economic feasibility assessment
5. Consideration of any other factors that affect BAT/BEP determination
6. The selected BAT/BEP

6.1.1 Technologies and Practices

Established and emerging technologies and practices were identified to meet the energy needs of the Project during the construction, operations, and decommissioning phases. The technologies considered in the BAT/BEP determination process are presented in Table 6.1. As per the SACC Technical Guidance (ECCC 2021a) the BAT determination is only required for sources anticipated to produce 1% or more of the total GHG emissions from the Project; thus other sources have been excluded from Table 6.1. Depending on the BAT technological feasibility assessment, some of the BEP considered in Table 6.1 may not be relevant.

Table 6.1 List of Best Available and Emerging Technologies and Practices

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Construction	Carbon sinks	• None	• Biomass burning • Biomass chipping and spreading • Storage and decomposition • Merchantable timber recovery

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Construction	On-land equipment	• Diesel fueled Emerging: • Electric (battery) • Renewable diesel • Biodiesel fueled • Hydrogen-based electric • LNG fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Operations	Acquired energy	• Connection to Ontario electricity grid with back-up generators on-site • Combined cycle gas-turbine on-site • Wind energy • Solar energy • Steam turbine with grid interconnectivity and biomass combustion on-site	• Energy efficiency measures • Regular maintenance of equipment (on-site only) • Measurement of electricity consumption
	On-land equipment	• Diesel fueled • Trolley assist • Autonomous vehicles Emerging: • Electric (battery) • Biodiesel fueled • Renewable diesel • Hydrogen-based electric • LNG fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
	Carbon sinks	• Passive mineral carbonation: Atmospheric CO_2 capture in mined ore and tailings • Active mineral carbonation: IPT Carbonation Process	• Site remediation
Decommissioning	Carbon sinks	• None	• Site remediation
	On-land equipment	• Diesel fueled Emerging: • Electricity (battery) • Biodiesel fueled • Renewable diesel • Hydrogen-based electric • LNG fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)

A description of the various technologies and practices being considered, as well as the technological feasibility of implementing identified GHG reduction technologies at the Project site can be found in the following sections.

6.1.1.1 On-land Equipment

On-land equipment for mine site construction, operations and decommissioning includes heavy machinery such as mining drills, bulldozers, excavators, shovels, graders, crushers, as well as haul trucks. Diesel is the fuel typically used by mining equipment; with some smaller off-road equipment and smaller on-road fleet vehicles using gasoline or propane. The focus of this assessment is on equipment that is large enough to use diesel; gasoline and propane powered equipment are excluded due to size, limited combustion and relatively limited contribution to the Project's GHG emissions.

6.1.1.1.1 Diesel

Diesel is the conventional fuel used by on-land equipment for the construction, operations and decommissioning of mines. In the mining industry, this includes equipment such as wheel loaders, large mining trucks and large excavators. The diesel fuel is typically trucked to sites in bulk and stored in tanks before equipment fueling. A diesel engine combusts diesel with air in a compression-ignition engine. The combustion of diesel fuel releases GHGs and air contaminants, such as nitrogen oxides, into the atmosphere.

The use of diesel-fueled equipment is well established in the mining sector. Regulatory requirements and best operational practices for diesel storage and fueling technologies are well defined in Canada, with implementation of diesel-fueled equipment carrying very low capital and operational risk.

The use of diesel fuel in on-land mining equipment is technically feasible. The Canadian government proposed in 2021 that the sale of light-duty vehicles with internal combustion will be restricted after 2035, therefore it is possible that diesel, biodiesel, and renewable diesel will not be available during decommissioning for light-duty vehicles. However, there is currently no similar proposal regarding heavy duty vehicles. Therefore, for the Project, it is assumed that diesel remains commercially available and manufactured construction equipment will still have the option of using diesel once decommissioning begins.

6.1.1.1.2 Biodiesel

Conventional on-land diesel powered equipment that operates on petroleum derived diesel can also use biodiesel blends, with all major North American diesel engine manufacturers approving the use of B5 (5% biodiesel blend). Biodiesel is produced from renewable feedstocks, such as soybean oil and animal fat, through a process known as transesterification (NRCAN 2020). Compared to conventional diesel, biodiesel has the potential to reduce GHG emissions by over 80% on a life cycle basis and reduces tailpipe emissions such as particulate matter, hydrocarbon and carbon monoxide from most modern four-stroke diesel engines (NRCAN 2020).

The Ontario Cleaner Transportation Fuels (O. Reg. 663/20) regulation requires fuel suppliers to blend 4% renewable content in diesel fuel. Biodiesel is a temperature sensitive fuel, with the formation of crystals that can plug the fuel filter representing a risk at low temperatures. Using a low biodiesel blend (5%) can alleviate this issue and represents a technically feasible blend level in conventional diesel powered on-land equipment.

Based on the cold climate of Northern Ontario and the low temperature sensitivity of biodiesel, it is only technologically feasible to deploy biodiesel blends at a 5% biodiesel blend rate, which is not expected to materially impact combustion emissions compared with the Ontario legislative requirement of a 4% biodiesel blend rate in conventional diesel fuel. Furthermore, based on planned increases in renewable biodiesel manufacturing capacity in Canada and the improvements that renewable diesel has over biodiesel blends, for this assessment the assumption for the Project is that renewable diesel would be prioritized over biodiesel, representing a more promising fuel type for emissions reductions.

6.1.1.1.3 Renewable Diesel

Renewable diesel, also referred to as hydrogenation-derived renewable diesel, is produced from the same feedstocks as biodiesel through a process involving hydrotreating, isomerization, and fractionation. Hydrotreating uses hydrogen and high temperature and pressures to convert the oils in the feedstock to simple paraffins (Digital Refining 2010). Isomerization results in the specific chemicals required and fractionation results in the finished product. This equipment is commonly found at traditional oil refineries. Chemically, renewable diesel is the same as petroleum-derived diesel, has a better emissions profile, and has better low temperature operability (Valero 2022). Renewable diesel does not need to be blended with petroleum diesel; it can be used directly with existing engines and infrastructure (Valero 2022).

Renewable diesel first came on the Canadian market in 2019 and was originally available in Vanderhoof and Quesnel, British Columbia (Federated Co-operatives Limited 2019). However, renewable diesel is not currently manufactured in sufficient quantifies for large scale use in Canada. It is produced at locations in the United States, including Louisiana, Washington, and California, with an estimated 1.92 billion gallons per year (Cheers Interactive (India) Private Limited 2022; Pratt 2022a). In August 2022, Canadian canola has been approved as a feedstock for renewable diesel and biodiesel in the United States (Pratt 2022a).

The International Energy Agency (IEA) predicted that the global demand for renewable diesel is expected to triple between 2021 and 2026 (IEA 2021b). The leading driver of this demand are government policies, particularly in the United States and Europe.

The implementation of the Canadian federal government's 2020 Clean Fuel Regulations has been a major driver in the development of renewable diesel production in Canada. With the requirement for liquid fuel suppliers to gradually reduce the carbon intensity of fuels produced and sold in Canada, with a target of decreasing the 2030 carbon intensity of gasoline and diesel consumed to 15% below 2016 levels.

As of May 2023, seven new Canadian renewable diesel facilities are planned, or under construction, in Alberta, British Columbia, Quebec and Newfoundland and Labrador. These facilities are expected to add up to 4 billion litres per year of renewable biodiesel production by 2027, up from zero in 2020 (Canada Energy Regulator, 2023).

Plans for Canadian production of renewable diesel have been announced by several major hydrocarbon producers, including:

- Imperial Oil is planning to build a 20,000 barrels per day renewable diesel facility at the existing Strathcona Refinery in Alberta (Morgan 2021). This facility would use hydrogen generated from natural gas with carbon capture technology installed and vegetable oils to make renewable diesel. Imperial Oil plans for this new refinery to be operating in 2024.
- Federated Co-operatives Ltd. Announced a new renewable diesel fuel and canola-crushing plant is planned for Regina and will be producing approximately 15,000 barrels per day of renewable diesel starting in 2027 (Djuric 2021).

As the Canadian renewable diesel market is in its early stages of maturity, renewable diesel currently represents an emerging technology that is unlikely to represent a technologically feasible source of fuel during the construction phase of the Project (i.e., 2025 -2027). Based on increased renewable diesel manufacturing capability in Canada expected toward 2027, sourcing enough renewable diesel to meet the fuel demands of the Project may become a technologically feasible option during the operational phase of the Project (i.e., post 2027). For the purpose of this BAT/BEP assessment it is assumed that renewable diesel will represent a technologically feasible diesel alternative during the operations and decommissioning phases of the Project.

6.1.1.1.4 Trolley Assist Haulage

Trolley-assist truck haulage uses hybrid diesel-electric haul trucks and directs grid-based electrical power directly to the truck via an overhead trolley-line. Haul trucks, transporting the ore or waste from the rock face to the dump point, use the most energy out of a conventional underground mining fleet. A trolley assist system allows for the use of grid electricity to propel the motors of haul trucks, through the connection of haulage trucks to overhead trolley-lines. Benefits of trolley-assisted haulage can include increased productivity and fuel savings, decreased engine wear, and reduction in GHG emissions through increased efficiency and use of lower carbon grid electricity compared with diesel combustion (SMS Equipment 2024).

A trolley-assisted haulage system consists of an AC power supply, traction substation(s), rectifier(s) and the associated control and protection systems, the overhead trolley-system and a pantograph mounted on the truck. Conventional trolley assist haulage systems were designed with a focus on uphill travel, where cost savings are shown to be most substantial, however mines are increasingly considering trolley assist for flat hauls to reduce diesel consumption and extend the life span of truck engines (Global Road Technology 2022).

Trolley assisted haulage is a technologically feasible haulage system that has been an available technology for many years, with many trolley-assisted haul truck manufacturers (e.g., Komatsu, Hitachi) providing haulage for open-pit mining operations with different truck size requirements. Installing a trolley-assisted haulage system requires a robust implementation plan but can represent a positive step in decarbonizing mining operations. Copper Mountain Mine, located in Princeton, British Columbia deployed a trolley-assist hauling system for its open-pit mining operation in April 2022, with the hybrid-diesel electric haul trucks demonstrating reductions in diesel fuel consumption (SMS Equipment 2023). Based on proven commercial implementation in large-scale mining operations, trolley-assist haulage is considered technically feasible for implementation and inclusion in the Project's net-zero plan.

6.1.1.1.5 Autonomous Vehicles

Autonomous mining trucks are designed to haul mined material without the need for human intervention. The autonomous trucks are typically part of an Autonomous Haulage System (AHS) which includes a central control system, communication infrastructure and other supporting technologies. Autonomous vehicles typically utilize artificial intelligence, machine learning and a range of sensors, to perceive their environment, detect obstacles and make informed decisions. AHS systems can achieve a higher level of safety and productivity during haulage operations and greatly improve efficiency of overall operations (Mix Telematics, 2024). Improvements in efficiency may lower fuel consumption during mining operations and result in lower GHG emissions.

Deployment of AHS technologies is technologically feasible and has been increasing in recent years, with the number of Autonomous Haul Trucks (AHTs) in operation globally having increased from 861 to 1070 between May 2021 and May 2022 (FutureBridge 2022). In northeastern Ontario, the Cote Gold Open Pit gold mine, expected to produce around 440,000 ounces of gold annually over an 18-year life span, is planned to have 23 AHTs deployed once at full production, with 14 200 tonne capacity AHTs currently in operation (Republic of Mining 2024). Throughout 2023, Roy Hill's iron ore mine in Western Australia expanded its AHS system in partnership with Epiroc and ASI Mining. The AHS expansion planned to deploy 96 AHTs by the end of 2023, which included a mix of autonomous vehicles from original equipment manufacturers Caterpillar and Hitachi (Epiroc Group 2023).

As autonomous technology has been commercially implemented around the globe, for the purpose of the Project's net-zero plan it is assumed that autonomous vehicles are technically feasible for implementation and used throughout the operational life of the Project.

6.1.1.1.6 Electric

Rather than using fossil fuel combustion to power vehicles, electric-drive vehicles use batteries to store and provide energy. The electricity used to charge batteries could come from on-site generation or a connection to an electrical grid. Mining companies are increasingly adding electric equipment to their fleets, with benefits including emissions reductions with respect to conventional diesel equipment and reduced noise pollution. Leading manufacturers for battery-electric mining equipment include Caterpillar and Sandvik. Examples of battery-electric equipment deployment in Ontario are provided below:

- Glencore's Sudbury Integrated Nickel Operation has ordered a full fleet of Epiroc battery-electric equipment for use at one of its Ontario based nickel and copper mines, expected to start production in 2024. Electric machines ordered include scooptram loaders, minitruck haulers and drilling rigs (Electric Autonomy 2022).

- In northern Ontario, Newmont Goldcorp has been operating the Borden gold mine since October 2019, which represents the first mine in Canada to replace all diesel mobile equipment with battery-electric vehicles. The mine is expected to have a life span of 7 to 15 years, with an ore production capacity of 4,000 tonnes/day. The battery electric fleet equipment is sourced from Sandvik, with equipment including drilling rigs, scoops, and 40 tonne haul trucks (Mining Technology 2020).

If purchased electricity used to charge electric vehicles is generated largely from renewable sources (e.g., solar, wind and hydroelectric), electric vehicles have the potential to offer a benefit in terms of GHG emissions relative to conventional fossil fuel powered mining vehicles. As the Ontario electricity grid is driven predominately by renewable generation (94% of electricity generated in Ontario was produced from low/no GHG emissions sources in 2022) (Government of Canada 2024), the GHG emission reduction associated with implementation of electric mining vehicles is promising. However, the potential emissions reductions associated with electric mining vehicles is heavily dependent on the Ontario electricity grid carbon intensity remaining low over the lifetime of the Project, which will depend on numerous social, technological and economic factors outside of Canada Nickel's control.

As described above, electrification of mining fleet equipment has been proven technologically feasible for smaller scale mining operations through implementation in recent years in both Canada and Globally. However, battery electric equipment at the scale required for the Project are not currently commercially available for full fleet deployment. The use of battery-electric equipment is technologicallyfeasible for the Project, as grid electricity is planned to be provided to the Project site via a 230 kV electricity transmission line planned to be installed from the Porcupine substation near Timmins, Ontario (Canada Nickel 2022). Based on the large-scale of the Project, it is unlikely that fully electric mining operations will be feasible upon commencing operations but that we will see increasing feasibility for equipment electrification over the operational lifespan of the Project.

6.1.1.1.7 Hydrogen-based Electric

Hydrogen fuel cell technology is relatively new. The fuel cell generates electricity through the chemical reaction between hydrogen and oxygen. Provided that there is a zero-carbon source of hydrogen, no GHGs are released from the use of a hydrogen fuel cell; water is the only by-product. Like an electric battery in a vehicle, a hydrogen fuel cell remains in the equipment and is refueled similar to gasoline or diesel.

Hydrogen fuel cells are already in use in approximately 11,000 cars and in over 20,000 forklifts globally (IEA 2019). Fuel cells are also in use in buses and trains globally (Government of Canada 2019).
One type, the Ballard Power System, can provide up to 200 kilowatt (kW, 248 hp) and is commercially ready for deployment in buses, trucks, and light rail applications (Government of Canada 2019).

With regards to hydrogen used in mining equipment, there are no commercially available mining equipment currently in the market, however leading manufacturers have announced prototypes and plans to incorporate hydrogen fuel cells in mining equipment. Of note is the proof-of-concept vehicle, the nuGenZero Emission Haulage Solution, produced through a collaboration by Anglo American, ENGIE, Plug Power and Ballard Power Systems. The 290 imperial ton fuel cell hauler is currently active at Anglo

American's Mogalakwena Platinum mine, representing the world's largest heavy-duty hydrogen vehicle. Additionally, in December 2023, General Motors and Komatsu announced plans to co-develop a hydrogen fuel cell power module for Komatsu's 930E electric drive mining truck. General Motors and Komatsu intend to test the first prototype vehicle at Komatsu's Arizona Proving Grounds research and development facility in the mid 2020s.

Currently, most of the hydrogen used globally is produced from fossil fuels; a small fraction of hydrogen is produced via electrolysis (IEA 2019). Less than 0.7% of current hydrogen production is from renewables or from facilities equipped with carbon capture technologies. The production of hydrogen using current fossil fuel technologies is GHG intensive, responsible for approximately 830 million tonnes of CO_2 per year. The source of the energy used to produce hydrogen dictates how decarbonized the hydrogen value chain is. Recently, colours are being used to describe the different energy sources used to produce hydrogen. Hydrogen produced via fossil fuels without carbon capture technologies is referred to as "black" (from coal), "grey" (from CH_4), and "brown" (from lignite), whereas fossil fuel systems with carbon capture produce "blue" hydrogen. Hydrogen that is produced using renewable electricity is referred to as "green" (IEA 2019).

Based on this information, hydrogen fuel cells in on-land mining equipment are not technically feasible currently but may become feasible as early as 2030. Depending on how hydrogen production and hydrogen fuel cell technologies for mining equipment advance in future years, hydrogen may become a technically feasible fuel during the operational life span of the Project, however based on the already low carbon intensity of the Ontario electricity grid, the maturity of electric mining equipment relative to hydrogen powered equipment, and the large scale of the Project, for the purpose of this assessment it is assumed that electrification is prioritized over hydrogen fuel cells.

6.1.1.1.8 LNG Fueled

Liquefied Natural Gas (LNG) is natural gas that has been cooled to a low temperature of -162 °C to become liquid. Currently available natural gas vehicles may run solely on natural gas, operate using a bi-fuel system (gasoline and natural gas), or a dual-fuel system that uses diesel for ignition assistance. Although manufacturers offer natural gas vehicles directly, aftermarket conversion kits for traditionally gasoline or diesel vehicles are also available (Federated Co-operatives Limited 2019). Relative to conventional mobile fuels, such as gasoline and diesel, LNG burns cleaner, which can lower pollution and GHG emissions, with carbon dioxide emissions from fuel combustion reduced by up to 30%. Additionally, LNG-powered equipment is often more energy efficient relative to conventional diesel-powered equipment, resulting in lower energy demand and resultant GHG emissions.

Recent technological advancements have enabled the adoption of natural gas in mine haul trucks. As remote mining operations often lack access to the electrical grid, the integration of LNG provides an off-grid energy solution that can reduce reliance on conventional diesel fuel. To utilize LNG as a fuel source, mining equipment needs to be modified, which involves retrofitting existing fleet equipment with LNG conversion kits or investing in new LNG-powered machinery. Prior to implementing LNG, mining companies typically conduct a comprehensive feasibility assessment, examining the availability of natural gas reserves, infrastructure requirements, cost projections and regulatory compliance to determine if LNG deployment is suitable.

There are currently four LNG liquefaction facilities, and two LNG import facilities, operating in Canada that serve the domestic LNG market, with most facilities operating at low volume. Of the four liquefaction facilities, three are located in British Columbia, supplying LNG for industrial, residential, mining and the ferry sectors, with one facility located in Montreal, Quebec. LNG use at the Project site will require liquefaction at existing facilities and transport to the Project site via large-haul LNG tankers or the development of a liquefaction facility on-site with connection to the natural gas pipeline system, both of which will substantially increase life cycle GHG emissions of the Project. Additionally, a fueling station will be required to be built on-site for the fueling of mining equipment.

As LNG is typically used in remote mining locations where connection to an electricity grid is not available, it is unlikely that the Project will utilize LNG over grid electricity, based on the plan to provide the Project site with electricity via a 230 kV electricity transmission line installed from the Porcupine substation near Timmins, Ontario. Given the availability and already low GHG intensity of the Ontario electricity grid, for the purpose of this assessment it is assumed that electrification is prioritized over the use of LNG in on-land mining equipment.

6.1.1.2 Energy Sources

Stationary equipment units that require energy in the form of electricity or heat to operate require a reliable primary energy source. This energy source may be located at the Project or located distantly with appropriate equipment to transport the energy to the Project. For this assessment, five energy sources are considered.

6.1.1.2.1 Connection to the Ontario Electricity Grid

As of 2022, approximately 94% of electricity generated in Ontario is produced from low/no GHG emission sources, with 59% being from nuclear sources, 26% from hydroelectricity and 9% from wind and solar sources (Government of Canada 2024). Due to the predominant use of low carbon electricity generation sources, the Ontario electricity grid has a low GHG intensity relative to the Canadian average, with the 2020 Ontario electricity generation GHG intensity representing just 23% of the Canadian average GHG intensity (Canada Energy Regulator 2024).

Electric power for the Project is planned to be supplied through the development of a new 230 kV electricity transmission line from the Porcupine substation near Timmins to the Project site, where it will intercept the Project property edge and interface with the site electrical system via a Ring-Bus.

Once the transmission line is ready for use, the Project is expected to operate using electricity from the Ontario electricity grid throughout its lifetime. In the event of an outage and/or during the early construction phase of the Project, a back-up/emergency energy source such as diesel-fired generators may be required.

The proposed connection to the electrical grid is technically feasible, although the use of grid electricity by Canada Nickel as the primary energy source for the Project will depend on implementation by a third-party, with Canada Nickel involved as a customer once construction is complete and the 230 kV transmission line is operational. The third-party owner will be responsible for the design, construction, connection and operation/maintenance of the line. Furthermore, the success of the electricity grid in reducing Project GHG emissions in line with the net-zero plan, will be dependent on the continued low GHG emissions intensity of the Ontario electricity mix throughout the life of the Project.

6.1.1.2.2 On-Site Combined Cycle Gas Turbine

Self-generation of electricity at the Project site using combined cycle gas turbines would require the construction of a combined cycle power generation facility. Fuel supply for the power facility would be taken from the Ontario natural gas transmission system. Electricity generation via a combined cycle gas turbine would generate air contaminants and GHG emissions from the combustion of natural gas used to drive the gas turbine and generate electricity. Combined cycle gas turbines are mature technologies that pose little risk to implementation, beyond the additional capital to build the required generation capacity. The use of combined cycle gas turbines for electricity generation is considered technically feasible to implement at the start of the Project.

6.1.1.2.3 Wind Energy

Wind power is generated from the rotation of a turbine's rotors by the wind to spin a generator.
Wind turbines for commercial electricity generation are typically 50 m to 105 m tall and can be rated between 1 MW and 3 MW per turbine (Bhandari et al. 2020). Turbine rotor diameters for a 2.8 MW turbine can be up to 132 m (GE Renewable Energy 2022).

As of 2022, the Ontario electricity grid had 5,575 MW of installed wind capacity, representing approximately 6% of Ontario's total electricity generation capacity.

The area needed for a wind turbine farm is substantial. While the individual footprint of a wind turbine is small (approximately 0.01 km^2 [NREL, nd]), the standard distance between wind turbines is between 5 and 10 turbine diameters (660 m to 1,320 m for turbines with 132 m diameter rotors), increasing the total required land area.

When siting wind turbines, the wind resource at the turbine elevation must be considered. Looking at the estimated wind resource over the Project site as shown by Global Wind Atlas (2024), the mean power density for the 10% windiest areas in the vicinity of the Project site is around 225 watts per square meter (energy per turbine sweep area) at 100 m elevation, and the mean wind speed is approximately 6 meters per second (m/s).

Although the approximate wind speed at the Project site represents a moderate level wind regime, capable of powering a wind energy system according to Natural Resources Canada's Wind Energy Systems Buyers Guide, a large amount of land area will be required to install sufficient wind energy equipment. This is not currently technologically feasible given that the majority of land within the PA area will be used for core mining operations and associated infrastructure, however it may become technologically feasible over the Project lifetime as land is reclaimed to construct and operate a small number of turbines to decrease the amount of energy required from the Ontario electricity grid over the Project's lifetime. Due to the variable nature of wind energy supply, and the technological feasibility of supplying low carbon Ontario grid electricity to the Project site, the use of grid electricity is selected over wind energy for further BAT/BEP assessment.

6.1.1.2.4 Solar Energy

A photovoltaic system using solar panels generates electricity from solar irradiance. Large scale solar farms are typically mounted on structures on the ground. The efficiency of the system's technology to convert sunlight to energy dictates the physical footprint required to generate a specified amount of power. The efficiency of modern solar panels generally ranges from 15 to 22%, with some high-end models surpassing 22% (TEMA 2023).

The amount of solar irradiance at a given location varies daily depending on weather (e.g., cloud cover), season, and sun activity, but can be approximated based on historical weather conditions. As shown by the Global Solar Atlas (2024) the Project location is estimated to be able to produce between 1,200 to 1,300 kWh/kilowatts peak (kWp)/year of photovoltaic electricity. Therefore, to produce the estimated maximum annual electricity demand of the project of 2,134.82 megawatt-hours (MWh), a solar farm with a minimum installed capacity of between approximately 1,640 to 1,780 MW would be required. For context, this is approximately upwards of 3.5x the size of the Travers Solar Project, Canada's largest photovoltaic power station, which has a capacity of 465 MW and covers a land area of approximately 14 km^2.

The availability of solar energy is intermittent. Because electricity is in constant demand, a back-up system to provide electricity when solar energy is not available would be required.

Due to the low level of solar irradiance and the resulting large land area required to install sufficient solar energy equipment at the Project site, the use of this technology to meet the Project's entire energy needs is not technically feasible. Further study would be needed to determine whether sufficient solar irradiance is present to warrant consideration of solar power to offset electricity use from the Ontario electricity grid; for the purpose of this assessment, it is assumed that solar power would not be technically feasible at any point in the Project's lifetime.

6.1.1.2.5 Steam Turbine with On-Site Biomass Combustion

Biomass combustion in a boiler can be used to produce electricity when high-pressure boiler steam is run through a steam generating turbine. This system can also be designed to heat in a combined heat and power (CHP) setup, where spent steam from the power plant is used for manufacturing processes or for building heat. The use of biomass offers the advantage of dispatchability relative to many other renewable energy options, with energy available as needed, similar to fossil fuel electric generation systems (Whole Building Design Guide 2016). In addition to biomass, a large amount of process water is required for this operation.

Wood chip-fired electric power systems are typically estimated to use one dry ton of wood of wood per megawatt-hour of electricity produced (Whole Building Design Guide 2016). With the Project estimated to result in the removal of approximately 1.5 million tons of biomass as above-ground living biomass and dead organic material, if this was assumed to all represent useable wood in an electricity generation system, this could at best supply approximately 2% of total estimated electricity demand of the Project, indicating the requirement for wood waste to be sourced externally if a biomass combustion system is desired to supply a meaningful amount of power for the Project.

Typically, wood waste can be sourced from industrial activities such as pulp mills, which consistently generate high volumes of waste that require use or disposal. Due to the high energy load of the Project, a substantial amount of wood waste would be required annually for meaningful electricity generation. The closest pulp and paper mills to the Project site are the Thunder Bay Pulp and Paper Mill and the Papier Masson Mill in Gatineau Quebec, which each represent a distance of over 750 km from the Project site, with no known substantive wood waste sources located near the Project site in Northern Ontario. The large transportation distance and mass of feedstock required to supply the project with a meaningful amount of electricity generation is disadvantageous relative to the direct use of grid electricity given the significant added cost and GHG emissions associated with feedstock transportation at the required scale

A combined heat and power system to generate electricity using biomass is a mature technology. However, reasonably sourcing enough biomass to operate the system at this location over the lifetime of the Project would be difficult. Therefore, biomass combustion is considered to not be technically feasible either currently or over the Project lifetime.

6.1.1.2.6 Back-up / Emergency Energy Source

When the primary energy source is unavailable due to maintenance of the energy source, an unplanned outage, or during emergencies, a reliable back-up system is required to safely shutdown equipment and protect the health and safety of personnel. Such systems are typically fossil-fuel based as they are readily available, reliable, and can be tested for readiness periodically.

Diesel-fired generation may be used early in the construction phase and during the closure phase when grid power is not available to site. Emergency diesel generators will also be present on-site, however the Project does not anticipate the use of diesel power as a standard practice.

6.1.1.3 Carbon Sinks

Land clearing activities in mining typically include the removal of living and non-living biomass and carbon-containing soils using heavy construction and mining equipment. The extent of the clearing and the fate of the material influences the amount of GHG emissions released. Four environmental management practices are included in the assessment with respect to the mining construction phase and one is included with respect to operations and decommissioning.

With respect to the Project's construction phase, assessed environmental practices for handling removed biomass from converted lands include direct on-site burning, chipping and spreading, storage and decomposition and recovery and sale of merchantable timber. All four of these options are technologically feasible to implement, with the extent of feasible merchantable timber recovery dependent on the merchantable content of removed biomass. This will need to be assessed at the time of removal and if implemented will be conducted alongside other management practices for the non-merchantable fraction of biomass.

For the Project's operations and decommissioning phase, site remediation represents the major environmental management practice assessed for reducing project impacts to carbon sinks. Remediation will include progressive reclamation of natural land area impacted by Project operations.

In addition to management practices focused on handling removed biomass and minimizing impacts to carbon sinks, the role of both passive and active mineral carbonation in mined material as carbon sinks for the Project is assessed.

6.1.1.3.1 Passive Mineral Carbonation

Mineral carbonation includes naturally occurring reactions between minerals and atmospheric CO_2, resulting in permanent capture and/or storage of CO_2 in solid form (carbonates). Minerals with the ability to undergo carbonation include magnesium, calcium or iron minerals such as olivine, brucite, wollastonite and serpentine. The generic formula for mineral carbonation is as follows:

Mineral + $CO_2 \rightarrow MCO_3$ + heat

Passive mineral carbonation between minerals in mined material and atmospheric CO_2 occurs at two stages of the mining process. Passive carbonation first occurs during the mining and milling processes, where atmospheric CO_2 is passively captured by the wallrock of the Open Pit and in the mined ore during handling. The second stage involves carbonation of minerals in mine tailings after discharge to the Tailings Management Facility (TMF) and in waste rock stockpiles. The passive carbonation of minerals in mined material is limited by CO_2 supply, especially in the TMF where tailings are continuously covered with fresh discharge.

Passive mineral carbonation is a natural chemical process known to occur with mined material and is thus an applicable carbon sink for the Project.

6.1.1.3.2 In Process Tailings (IPT) Carbonation Process

Canada Nickel plans to implement a novel IPT Carbonation process capable of harnessing the natural mineral sequestration capabilities of host rock to actively capture a concentrated source of CO_2. In this active carbonation process, tailings generated by the milling process are conditioned with a concentrated source of CO_2 after tailings thickening and before discharge to the TMF. CO_2 delivered to the site is sparged into the tailings slurry in a controlled manner to maximize CO_2 exposure to mineral surfaces and promote faster and more complete mineralization reactions. Carbonation tanks for this process have been designed to allow for recompression and recirculation of unreacted CO_2 to maximize CO_2 utilization.

To assess technological feasibility, pilot plant testing of the IPT carbonation process was completed in the summer of 2023, which confirmed the ability to scale up the process as well as the ability to sequester an average of 1.3 Megatonne/annum of CO_2 over the operational life of the mine (Canada Nickel 2024). Pilot plant testing also validated the sequestration models that were developed. The IPT Carbonation process requires a supply of CO_2 from an industrial partner as capture of emissions from the Project's main GHG emissions sources (e.g. mobile equipment) is not technically feasible. Canada Nickel is actively looking at ways in which it could work with industrial emitters to supply CO_2 to the facility. Once the supply of CO_2 is available, the process is technically feasible.

6.1.1.4 Practices to Reduce Energy Use and/or GHG Emissions

The identified BEP in Table 6.1 aim to achieve reductions in GHG emissions through reduced operational energy use or through mitigation of direct GHG emissions. Practices focused on reduced energy use are largely policy based and focus on increasing efficiencies and eliminating unnecessary energy consumption. Practices focused on mitigating GHG emissions include optimizing carbon sequestration in mined ore and tailings and lowering biomass emissions from disturbed carbon sinks. All practices listed in Table 6.1 are technically feasible.

6.1.2 Technological Feasibility Summary

The BAT/BEP that were considered technically feasible in the section above and that will be carried forward are shown in Table 6.2.

Table 6.2 Results of Technical Feasibility Assessment

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Construction	Carbon sinks	• None	• Biomass burning • Biomass chipping and spreading • Storage and decomposition • Merchantable timber recovery
	On-land equipment	• Diesel fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Operations	Carbon sinks	• Passive mineral carbonation: Atmospheric CO_2 capture in mined ore and tailings • Active mineral carbonation: IPT Carbonation Process (with CO_2 supply)	• Site remediation

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Operations	Acquired energy	• Connection to ON electricity grid with back-up diesel generators on-site • Combined cycle gas-turbine on-site	• Energy efficiency measures • Regular maintenance of equipment (on-site only) • Measurement of electricity consumption
	On-land equipment	• Diesel fueled • Trolley assist • Autonomous vehicles Emerging: • Electric (battery) • Renewable diesel • Biodiesel fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Decommissioning	Carbon sinks	• None	• Site remediation
	On-land equipment	• Diesel fueled • Biodiesel fueled • Renewable diesel Emerging: • Electricity (battery)	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)

6.1.3 GHG Reduction Potential

The GHG reduction potential for each selected technology is estimated against a baseline “business as usual” (BAU) case for each source.

6.1.3.1 On-land Equipment

For the purpose of estimating the GHG reduction potential, the BAU case for on-land mining equipment is assumed to be the use of conventional diesel-powered equipment for all mining operations. Alternative scenarios for on-land equipment considered in this assessment involve lowering the carbon intensity of the fuel and/or increasing the energy efficiency of mobile sources in mining operations.

6.1.3.1.1 Diesel

The GHG emissions from on-land mining equipment combusting diesel fuel during Project construction, operations and decommissioning, were estimated to be approximately 12,076 kilotonnes CO_2e. This estimate assumes all mining equipment is powered by conventional diesel fuel, no GHG reduction technologies have been implemented, and that to supply the Project with the required quantity of diesel fuel, class 8 heavy-duty diesel tankers with a maximum capacity of 5000 L (Transport Canada 2022) and a fuel consumption of 39.5 L/100 km (NRCAN 2019a) are used to ship fuel from one of the three major refineries in Sarnia, ON (i.e., Imperial Oil, Suncor and Shell), which typically supply petroleum fuel to

Northern Ontario (Canada Energy Regulator 2024). The BAU emissions estimate was calculated using Ontario specific on-road diesel fuel emission factors from Canada's latest NIR (NIR 2023) and the estimated total diesel fuel consumption of Project mining equipment and of heavy-duty fuel transportation tankers over the lifetime of the Project.

6.1.3.1.2 Biodiesel and Renewable Diesel

In Canada, CO_2 emissions that are released from the combustion of biodiesel and renewable fuels are generally considered biogenic and therefore reported on and discussed separately from CO_2 emissions generated from fossil fuel combustion. CH_4 and N_2O emissions from the combustion of biodiesel and renewable fuels however are considered in the same way as non-biogenic sources. For the assessment of the Project, two biogenic fuel replacement options are considered: biodiesel (at 5% biogenic content) and renewable diesel (at 100% biogenic content). By replacing 5% of the required diesel with biodiesel it is estimated, using the same calculation methodology as the BAU scenario, that the Project GHG emissions from on-land equipment would decrease by approximately 458 kilotonnes CO_2e or 4% from the BAU scenario. This assumes a similar transportation distance as the BAU scenario, considering that a 4% blend rate of biogenic diesel is required by the province of Ontario under the Ontario Cleaner Transportation Fuels regulation.

Under the renewable diesel scenario, by replacing 100% of the required diesel with renewable diesel, the estimated Project GHG emissions from fuel combustion for on-land equipment decrease by approximately 9,187 kilotonnes CO_2e or 76% from the BAU scenario. The estimated emissions reduction for the renewable diesel scenario was calculated assuming that under a best-case scenario in terms of transportation distance, the Project can predominately source the renewable diesel from the Varennes Carbon Recycling plant in Quebec, scheduled to be in commission in 2025 and to have an annual production capacity of nearly 122 million litres of renewable diesel (Canada Energy Regulator, 2023).

6.1.3.1.3 Electric

Electrifying the entire fleet of mining equipment has the potential to decrease Project GHG emissions from on-land equipment by approximately 11,780 kilotonnes CO_2e or 98% from the BAU scenario. This estimate assumes the entire on-land equipment fleet is electric and that the powertrain efficiency of electric mining equipment is approximately 90%, versus a diesel powertrain efficiency of 45% (E & MJ, 2020). Emission reduction estimates associated with the conversion from diesel to electric mining equipment were calculated using expected equipment energy requirements, fuel versus electric powertrain efficiencies and Ontario specific projected electricity grid emission factors from the ECCC data catalogue (ECCC 2023a). The substantial estimated reduction in GHG emissions from electrification is a combination of the already low GHG intensity of the Ontario electricity grid and expected further grid decarbonization toward 2050. Electrification offers the advantage of no operational upstream emissions associated with transportation, as is the case with the low-carbon and BAU diesel fuel scenarios.

6.1.3.1.4 Trolley Assist Haulage

As part of a 2023 Technical Feasibility Study for the Project, the implementation of trolley-assist haulage for 290 imperial ton haul trucks was evaluated and the electricity required for the trolley-assist system was estimated to amount to approximately 62% of total electricity demand of pit mining operations (Ausenco 2023). Assuming that the estimated electricity supplied for trolley-assisted haulage replaces conventional diesel fuel, and that haul trucks have an electric powertrain efficiency of 90% and a diesel engine efficiency of 45% (E & MJ 2020), results in estimated Project GHG emissions reductions of 3,080 kilotonnes CO_2e or 26% from the on-land equipment BAU scenario. Additional GHG emissions associated with installing the overhead trolley lines are unlikely to be material relative to operational emissions from electricity use, given that additional land use relative to roadways will be minimal given overhead construction and embedded carbon from construction materials will be a one-time impact during the construction phase rather than occurring throughout the operational life of the mine.

6.1.3.1.5 Autonomous Vehicles

Deploying autonomous mining vehicles can lead to a 10 to 15% decrease in total fuel consumption relative to conventional mining equipment (IISD 2016). Using the conservative end of this range, if autonomous mining vehicles were to be implemented such that Project mining operations are assumed completely autonomous, this would result in Project GHG emissions reductions of approximately 905 kilotonnes CO_2e or 7% from the BAU scenario. If autonomous mining vehicles were to be implemented alongside trolley-assist haulage, emissions reductions could amount to approximately 33% of the diesel BAU scenario. No material sources of added emissions are expected for the implementation of autonomous mining vehicles.

6.1.3.2 Energy Sources

The BAU case for stationary energy sources is assumed to be the use of Ontario grid electricity, as a new 230 kV electricity transmission line is planned to be installed to deliver electricity to the project site (Canada Nickel 2022). The alternative scenario deemed technologically feasible for energy supply includes the use of electricity generated on-site via a combined cycle power plant.

Using grid electricity is demonstrated to be the lowest carbon scenario for energy supply. The use of grid electricity results in approximate emissions reductions over the life of the Project of 21,695 kilotonnes CO_2e or 98% compared to using a combined cycle natural gas power plant to generate electricity on-site. Using an on-site combined cycle power plant to generate electricity is disadvantageous from a GHG perspective based on the low carbon intensity of the Ontario electricity grid and the typical power generation efficiency of 63% for combined cycle power plants (IPIECA 2022). Additionally, further emissions would be expected from construction of the combined cycle power plant and the additional land use requirement.

6.1.3.3 Carbon Sinks

6.1.3.3.1 Carbon Sequestration

Two carbon sequestration scenarios were investigated for the current assessment: passive mineral carbonation and active mineral carbonation through the IPT carbonation process.

Passive mineral carbonation will occur naturally between minerals in the mined ultraformic rock and atmospheric CO_2 throughout the mining process. Reacted CO_2 is permanently captured and/or stored in solid form as carbonates. Emission reductions associated with the passive mineral carbonation process will depend on numerous mining process specific factors that are currently unknown and therefore a quantified emissions reduction estimate for this process is not currently available.

The IPT carbonation process is a novel method developed by Canada Nickel to accelerate the natural mineral carbonation process through treatment of mine tailings with a concentrated CO_2 source. Based on preliminary pilot scale testing, the IPT carbonation process is estimated to have a maximum storage capacity of 32 kgCO_2/tonne tailings and to increase the rate of CO_2 capture by approximately 8 to 12 times relative to the rate of passive carbonation (Canada Nickel 2022). The IPT process is planned to be implemented at the start of the Project operations and is estimated to result in a projected average carbon storage capacity of 1.3 Megatonnes of CO_2 per annum or approximately 54 Megatonnes of CO_2 over the operational life of the mine (Canada Nickel 2024). Despite a high storage capacity, this represents a theoretical maximum, as the actual reduction in the Project emissions related to carbon sequestration by the IPT process will depend on the source of the sequestered carbon. If the carbon is sourced directly from Project emissions or from a Direct Air Capture (DAC) facility, this can offset Project emissions as Canada Nickel will have ownership of the emissions. However, if the sequestered carbon is coming from point source capture from other industrial facilities (e.g., power plants with carbon capture), although this could provide a Project benefit in terms of sequestration fees, it will not represent a negative source of emissions if already being accounted for by the primary emitter. For the purpose of this assessment, in alignment with the draft Technical Guide, (ECCC 2021a), and the financial analysis in the Mining Feasibility Study (Ausenco 2023), it is assumed that the sequestered carbon will be obtained from point source capture from other industrial facilities and therefore would not represent a negative source of emissions in this BAT/BEP or for the purposes of the net-zero plan. However, the net benefit of the IPT process, which would not be possible without the Project, to Canada's GHG emission reduction goals is discussed in Section 10.

6.1.3.3.2 Land Disturbance

Depending on the practice(s) used to manage biomass and soils, CO_2 or CH_4 can be released either quickly or slowly (over approximately 20 years or more). In general, recovery of merchantable timber provides the longest timeframe for preventing the associated carbon from entering the atmosphere and biomass burning provides the shortest timeframe. Chipping and spreading is a practice that will release CO_2 more quickly compared with storage and decomposition which will result in CO_2 and CH_4 emissions over approximately 20 years. The practices that would result in the least GHG emissions are recovery of merchantable timber and chipping and spreading. Project land use change emissions estimates indicate that if aboveground biomass (including living biomass and dead organic matter from forestland estimated to represent approximately 95% of the Project land conversion), is subjected to decomposition rather than burning, approximately 98,315 tCO_2e in GHG emissions could be avoided over the Project lifetime. For the purpose of quantification and inclusion in Table 6.3, immediate release of GHGs is assumed for both decomposition and burning, and the avoided emissions have been included under construction phase of the Project, where majority of land clearing is expected to occur.

6.1.4 GHG Reduction Potential Summary

Table 6.3 summarizes the estimated GHG reduction potential over the entirety of each Project phase for implementation of the respective technologies assessed to be technically feasible, when compared with the BAU scenarios of a diesel fuel powered fleet for all on-land equipment, the Ontario electricity grid for primary energy supply, and no active carbon sequestration via the IPT Carbonation process. The GHG reduction potential associated with the IPT Carbonation Process represents potential sequestration capacity, however the exact impact on the Project emissions will depend on the source of carbon dioxide which is discussed further in the selection of BAT/BEP and the net-zero plan. The emissions reductions associated with the use of Ontario grid electricity as the primary energy source and trolley-assist haulage (highlighted in grey on Table 6.3) are captured within the net emissions profile discussed in the Net Project GHG Emissions section (Section 4.5), as these were assumed implemented in preliminary technical feasibility studies (Ausenco 2023). All other GHG reduction potentials presented in Table 6.3 represent potential subtractions from the net Project GHG emissions profile.

As the required energy and fuel usage associated with the decommissioning phase of the Project is currently unknown, for the purpose of this assessment, it is assumed that emissions from decommissioning come predominately from heavy-duty on-land equipment, and that the fuel usage is equivalent to the construction phase of the Project. It is likely that fuel usage for decommissioning is lower than that of the construction phase. Similarly, it was assumed that the emissions reduction potential over the decommissioning phase is identical to the construction phase.

Table 6.3 Results of GHG Reduction Potential Assessment

Phase	Source	BAT	GHG Reduction Potential Over Project Phase (t CO_2e)
Construction	Energy sources	Grid electricity (relative to CCGT)	17,717
	Land Disturbance	Biomass decomposition relative to burning	98,315
Operations	Carbon sinks	Passive mineral carbonation	Insufficient Data
		IPT carbonation process	54,000,000
	On-land equipment	Biodiesel fueled	452,310
		Renewable diesel	9,069,012
		Electrification	11,632,454
		Trolley-assist haulage	3,079,895
		Autonomous vehicles	905,192
	Energy sources	Grid electricity (relative to CCGT)	21,676,830

Phase	Source	BAT	GHG Reduction Potential Over Project Phase (t CO_2e)
Decommissioning	On-land equipment	Biodiesel fueled	5,894
		Renewable diesel	118,171
		Electrification	147,416
		Trolley-assist haulage	16,011
Note: Grey highlights indicate initiatives included in net Project GHG emissions profile based on inclusion in preliminary technical feasibility studies prior to BAT/BEP assessment. All other GHG reductions represent potential subtractions from the net Project GHG emissions.			

6.1.5 Economic Feasibility

6.1.5.1 On-land Equipment

6.1.5.1.1 Biodiesel and Renewable Diesel

For the two evaluated low carbon diesel fuels, biodiesel and renewable diesel, the main economic difference from the conventional diesel case will be the price to obtain the fuel, given that conventional diesel-powered equipment can accept the evaluated 5% blend of biodiesel and 100% renewable diesel. Based on the minimum blend requirement of 4% of renewable fuel in diesel as mandated by the Ontario Cleaner Transportation Fuels regulation, there is no anticipated material change in cost between the 5% biodiesel scenario and the BAU diesel scenario for on-land equipment.

For renewable diesel, the Canadian market remains relatively immature at the current time with seven renewable diesel facilities in the planning or construction phase in Alberta, British Columbia, Quebec and Newfoundland and Labrador as of May 2023 (Canada Energy Regulator 2023). As a result, there is uncertainty related to the future price of renewable diesel in Canada. Looking at a more mature market, the U.S. Department of Energy shows that that in the State of California, the price per gallon of renewable diesel has been relatively comparable to conventional diesel from the period of January 2017 to January 2024, with an average retail price for renewable diesel and petroleum derived diesel of $5.37/gallon and $5.25/gallon respectively (US DOE 2024). This represents a price increase of 2.3% for renewable diesel relative to petroleum diesel.

Given that the average price of petroleum derived diesel for Timmins Ontario as of February 2024 was $1.66 CAD/litre (NRCAN 2024), assuming a similar price difference for the Canadian market would result in an added cost of 4 cents per litre of fuel consumed. However, if the federal minimum national carbon pollution price schedule for 2023 to 2030 from the federal Output-Based Pricing System (OBPS) regulation (SOR/2019-266) is accounted for, and the price is assumed to stay constant from 2030 onward, the estimated average cost of petroleum diesel over the Project lifetime could surpass that of renewable diesel. Thus, implementation of renewable diesel has the potential to be economically competitive with conventional petroleum diesel over the Project lifetime.

The cost of diesel and renewable diesel over the project lifetime is highly uncertain given that many factors, such as demand, supply, and regulations affect the prices. It is estimated that renewable diesel could become economically competitive with the BAU case of conventional diesel for on-land equipment, however prior to any implementation, Canada Nickel would assess the current economics of using renewable diesel.

6.1.5.1.2 Electric

Based on the economic analysis conducted in the Project Feasibility Study (Ausenco 2023) the estimated life-of-mine average total price for electricity is estimated to be $75 CAD/MWh. Using the estimated total electricity required to power a fully electric fleet of on-road equipment, the total average cost for operating the electric fleet per tonne Nickel equivalent produced was estimated to be $606 CAD/t Ni Eq. This is lower than the estimated cost of operating the on-road equipment fleet for the BAU diesel and renewable diesel scenarios of $3,402 CAD/ t Ni Eq and $2,574 t Ni Eq respectively. The estimated operational cost advantage of using grid electricity relative to the diesel fuels is driven largely by taking into account the scheduled federal price on carbon emissions.

Purchasing electric mining equipment will involve added upfront capital relative to conventional diesel-powered equipment. Electric mining equipment is estimated to cost on average 20% more than conventional equipment (Varaschin and De Souza 2015). Using a conservative approach that the total Project capital cost estimate for the mining equipment fleet (including initial, expansion and sustaining capital) of $2,022M CAD from technical feasibility studies (Ausenco 2023) increases 20% as a result of conversion to electric powered vehicles, results in $404M CAD in additional capital over the Project life, relative to a total estimated operational cost savings over the Project life of approximately $4,297M CAD for deploying an electric fleet of on-land equipment vs. a conventional fleet powered by renewable diesel. Thus, despite added capital, electrification is estimated to be economically competitive over the life of the Project.

6.1.5.1.3 Trolley Assist Haulage

Trolley assist uses overhead power lines to supply wheel motors with electric power from the electricity grid, rather than generating power using an on-board diesel engine as in conventional diesel haul trucks (Ausenco 2023). The most substantial contributor to the total cost of a trolley-assist system is energy costs. The value of potential cost savings relative to conventional diesel haul trucks is a function of the kilometers travelled on trolley and the relative prices for both diesel fuel and electricity. Given energy prices forecasted in the Project feasibility study, the energy savings associated with using trolley-assist haulage are estimated at $31 CAD/km travelled relative to using conventional diesel haul trucks (Ausenco 2023).

The use of trolley assist haulage can also reduce equipment costs of hauling fleets. Given the lower diesel fuel consumption rate for a truck travelling on trolley, the interval between overhauls and replacements can be extended relative to conventional diesel haul trucks.

The savings associated with trolley-assisted haulage are partially offset by the added costs associated with installation and maintenance of the trolley system. This includes installing the fixed infrastructure (e.g., trolley line, poles, substation and pantograph), ongoing maintenance of the physical infrastructure and the requirement for wider ramps to accommodate the trolley-assist infrastructure (Ausenco 2023).

The costs associated with implementing trolley-assist haulage for the 290 imperial ton haul trucks has been evaluated as part of the total Project economic analysis conducted in the Project Technical Feasibility Study (Ausenco 2023). The Project is estimated to have a post-tax Net Present Value (NPV), using a discount rate of 8%, of $2,475M and thus technologies built into the preliminary project plan are considered economically feasible (Ausenco 2023).

6.1.5.1.4 Autonomous Vehicles

The use of autonomous mining vehicles in mining operations has been demonstrated to cut operational costs associated with on-land equipment operation. Studies demonstrate that increasing the autonomy of mining truck fleets leads to substantial cost savings over time, from reduced operator salaries, reduced vehicle maintenance costs and optimization of fuel economy (Coast IPC 2024). The cost savings associated with autonomous equipment have been shown to scale relatively linearly with the quantity of conventional equipment replaced (Coast IPC 2024).

The Resolute Mining operation in Mali carries out their entire gold mining process using autonomous equipment, which has reduced the cost profile of the mine by as much as 15%. Although complete automation resulted in high upfront capital, as much as $10M - $15M, the mine is setup to ultimately cut total costs by 30% over the life of the mine (Mining Technology 2018).

Cost reductions associated with mine automation are supported by original equipment manufacturers such as Caterpillar, who offer advanced AHS solutions projected to reduce the operational costs of mines by an estimated 20% from haul truck conversion alone (Mining Technology 2021).

The total cost savings evident from mine automation despite upfront capital indicate that compared with the BAU case of conventional on-land diesel equipment, implementation of autonomous vehicles would be an economically feasible option to lower GHG emissions over the life of the Project.

6.1.5.2 Energy Sources

As the use of an on-site combined cycle power plant to generate electricity was shown to increase Project GHG emissions relative to the BAU scenario of using the Ontario electricity grid, no economic assessment will be conducted on this alternative scenario.

As discussed in above sections, electric power for the Project is planned to be supplied through the development of a new 230 kV electricity transmission line, and thus represents the BAU scenario for primary energy supply. The cost of electricity usage and transmission line construction for the Project has been evaluated in the economic analysis conducted as part of the Project Technical Feasibility Study (Ausenco 2023). The Project is estimated to have a positive post-tax Net Present Value (NPV), using a discount rate of 8%, of $2,475M and thus technologies like the use of grid-electricity that are accounted for in preliminary economic analysis are considered economically feasible (Ausenco 2023).

6.1.5.3 Carbon Sinks

6.1.5.3.1 Carbon Sequestration

As the passive carbonation of minerals in mined ore will occur naturally during mining operations, there is no economic impact associated with this means of carbon sequestration.

The active IPT Carbonation process actively carbonates mine tailings with a concentrated source of CO_2 thereby accelerating the mineral carbonation rate and increasing CO_2 sequestration capacity. According to the Project Technical Feasibility Study (Ausenco 2023), it is expected that if the Project is to store captured CO_2 on behalf of other industrial emitters, the Project could expect in excess of $25 CAD per tonne of CO_2 sequestered based on publicly known storage fees and communicated carbon price and policy status. Using pilot scale CO_2 sequestration data (Ausenco 2023) to estimate Project scale sequestration capacity, and an estimated $25 CAD per tonne CO_2 storage fee, this would result in an estimated revenue stream of over $1 billion CAD over the Project lifetime. The magnitude of this revenue stream will depend on the source of the CO_2 to be sequestered. In order for the sequestered CO_2 to count against the Project's direct GHG footprint, it will have to be captured on-site or purchased from emitters or DAC facilities and not counted against another facility's emissions.

Beyond the potential revenue generated from the IPT Carbonation carbon sequestration, the construction and operation of the IPT carbonation system will have added capital and operating costs relative to the BAU scenario for carbon sinks of no IPT Carbonation process. The use of the IPT carbonation process has been built into the detailed Project Plan and the capital and operating costs have been evaluated in the economic analysis conducted as part of the Project Technical Feasibility Study (Ausenco 2023), wherein the Project is estimated to have a positive post-tax NPV supporting economic feasibility.

6.1.6 Selection of BAT/BEP

6.1.6.1 Combination 1

Combination 1, described in Table 6.4, represents a scenario where renewable diesel is used to decarbonize emissions from on-land equipment during operations, with the Ontario electricity grid used for primary energy and IPT carbonation process deployed for carbon sequestration. This scenario allows for the use of conventional diesel mining equipment over the life of the Project and does not require purchasing more capital-intensive mining technologies such as battery electric equipment, trolley-assist haulage and autonomous vehicles.

Table 6.4 BAT/BEP – Combination 1

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Construction	Carbon sinks	• None	• Biomass chipping and spreading • Merchantable timber recovery
	On-land equipment	• Diesel fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Operations	Carbon sinks	• Passive mineral carbonation: Atmospheric CO_2 capture in mined ore and tailings • Active mineral carbonation: IPT Carbonation Process (with CO_2 supply)	• Site remediation
	Acquired energy	• Connection to ON electricity grid with back-up diesel generators on-site	• Energy efficiency measures • Regular maintenance of equipment (on-site only) • Measurement of electricity consumption
	On-land equipment	• Diesel fueled • Renewable diesel	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Decommissioning	Carbon sinks	• None	• Site remediation
	On-land equipment	• Diesel fueled • Renewable diesel	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)

6.1.6.2 Combination 2

Combination 2, described in Table 6.5, represents a scenario where additional capital is deployed to implement emerging technologies in mining such as electric mining vehicles and autonomous equipment, as well as hybrid-electric haul trucks and trolley-assisted haulage. Given the emerging status and added upfront capital of battery electric and autonomous mining equipment, implementation is expected to occur in a stepwise fashion throughout the length of the Project.

Table 6.5 BAT/BEP – Combination 2

Phase/Year	Source	Best Available Technologies	Best Environmental Practices
Construction	Carbon sinks	• None	• Biomass chipping and spreading • Merchantable timber recovery
	On-land equipment	• Diesel fueled	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Operations	Carbon sinks	• Passive mineral carbonation: Atmospheric CO_2 capture in mined ore and tailings • Active mineral carbonation: IPT Carbonation Process (with CO_2 supply)	• Site remediation
	Acquired energy	• Connection to ON electricity grid with back-up diesel generators on-site	• Energy efficiency measures • Regular maintenance of equipment (on-site only) • Measurement of electricity consumption
	On-land equipment	• Diesel fueled • Trolley assist • Electric (battery) • Autonomous vehicles	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)
Decommissioning	Carbon sinks	• None	• Site remediation
	On-land equipment	• Diesel fueled • Electricity (battery)	• Anti-idling policy • Optimal sizing • Regular maintenance • Traffic management plan (e.g., bussing) • Strategic site design (i.e., compact layout for reduced haulage distance)

6.1.6.3 Selected Emission Reduction Scenario

The scenario that is considered BAT/BEP for this Project is Combination 2. The technologies and practices selected for this scenario represent best available mining technologies and practices that can be reasonably implemented throughout the life of the Project.

Combination 1 was not selected as although renewable diesel has GHG reduction potential, implementation of the complimentary reduction technologies of battery electric equipment, autonomous operations and trolley-assist haulage offer more substantial GHG reduction potential in comparison, while remaining cost competitive despite added upfront capital, due to Canada's scheduled carbon price on fuels and the increased efficiencies associated with trolley-assist haulage and automation. Additionally, the GHG reduction potential of renewable diesel is limited by associated upstream emissions for fuel transport which are higher relative to the use of the Ontario grid electricity, which is already powered with predominately renewables and has the potential to decarbonize beyond current projections to meet Canada's net-zero goals.

Information on the GHG reduction potential, level of technology maturity, and barriers to implementation are presented in Table 6.6.

Table 6.6 Summary of Selected BAT/BEP

Phase/Year	Source	GHG Reduction Potential	Technology/Practice Maturity	Barriers
Construction	Carbon sinks	• Chipping and spreading can reduce the amount of carbon that becomes CH_4, which has a higher global warming potential than CO_2. • Opportunity to keep carbon sequestered in merchantable timber.	• Mature	• Financial barrier with respect to identifying, cutting, and transporting merchantable timber.
	On-land equipment	• BEP measures will decrease fuel consumption, resulting in fewer GHG emissions	• BEP measures are mature policy practices for reducing GHG emissions.	• No barriers
Operations	Carbon sinks	• Passive mineral carbonation will naturally sequester CO_2 (potential emissions reduction currently unknown) • Project GHG reduction potential of IPT carbonation process dependent on CO_2 source. Potential Project CO_2 storage capacity of over 40 Megatonnes.	• Novel – IPT process proven in pilot scale studies.	• Scale up and implementation of IPT process. • Sourcing of concentrated CO_2 source.

Phase/Year	Source	GHG Reduction Potential	Technology/Practice Maturity	Barriers
Operations	Energy Sources (electricity)	• Connection to ON electricity grid will result in a reduction of 98% in GHG emissions compared to a simple cycle gas turbine system. • BEP measures will reduce electricity consumption, resulting in fewer GHG emissions.	• Mature	• Delays in transmission line construction could result in the use of diesel generators. • No barriers to BEP.
	Back-up/emergency energy source	• Diesel generators do not provide a GHG reduction. • BEP measures will decrease fuel consumption, resulting in fewer GHG emissions.	• Mature	• No barriers
	On-land equipment	• Battery electric equipment can reduce GHG emissions by 99% compared to fossil fuel diesel. • Trolley-assist haulage can reduce GHG emissions by 26% compared to conventional diesel haul trucks. • Autonomous equipment can reduce GHG emissions by 8% relative to conventional equipment. • BEP measures will reduce fuel and electricity consumption, resulting in fewer GHG emissions.	• Electric and autonomous equipment are emerging technologies (commercial implementation in recent years). • Trolley-assist haulage is a mature mining technology. • BEP measures are mature policy practices for reducing GHG emissions.	• Difficult/delayed integration of autonomous equipment into existing operations • No barriers to BEP.

Phase/Year	Source	GHG Reduction Potential	Technology/Practice Maturity	Barriers
Decommissioning and Closure	Carbon sinks	• Site remediation can help lower GHG impact from land use conversion and removed carbon sinks	• Mature	• No barriers
	On-land equipment	• The use of battery electric equipment can reduce GHG emissions by 96% compared to conventional diesel equipment. • BEP measures will reduce fuel and electricity consumption, resulting in fewer GHG emissions.	• Electric mining equipment expected to be a mature technology at the start of decommissioning. • BEP measures are mature policy practices for reducing GHG emissions.	• No barriers

6.1.6.4 Eliminated Technologies and Practices

The following technologies and practices by source were eliminated during the BAT/BEP assessment:

- Carbon Sinks:
  - Biomass burning, storage and decomposition – based on GHG reduction potential
- On-land equipment:
  - Hydrogen-electric – due to technical feasibility
  - LNG Fueled – based on access to grid electricity (more common in remote mines without grid access)
  - Biodiesel – based on GHG reduction potential (maximum 5% blend technically feasible)
  - Renewable diesel – based on GHG reduction potential
- Energy Sources
  - On-site combined cycle gas turbine – based on GHG reduction potential
  - Wind energy – based on technical feasibility
  - Solar Energy – based on technical feasibility
  - Steam turbine with on-site biomass – based on technical feasibility

6.1.7 Comparison to Best-In-Class Projects

6.1.7.1 Voisey's Bay Nickel Operation

The Voisey's Bay Nickel Operation in Newfoundland and Labrador is nickel mining, milling and processing operation owned by Vale. In 2020 the operation represented approximately 58% of all nickel produced in Canada (Vale 2020). As of 2019, the carbon intensity of the nickel operations was among one of the lowest in the world, with reported emissions of 103,204 t CO_2e (Newfoundland and Labrador 2024) and a total production of 35,400 tonnes of nickel concentrate (NS Energy 2024), amounting to an estimated carbon intensity of 2.92 t CO_2e/t Ni. If the net-zero plan provided in Section 9 is implemented, prior to purchasing of carbon offsets, the Project could have a carbon intensity of approximately 0.23 t CO_2e/t Ni Eq at peak production, approximately 8% of the Voisey's Bay operation.

7 Climate Change Resilience

A climate change resilience assessment was completed as a separate report, Climate Change Resilience Assessment of the Project, which is appended to Chapter 30 of the Impact Statement: Assessment of Effects of Environment on the Project.

8 Upstream GHG emissions

The Project being an Open Pit mine does not have upstream GHG emissions related to the product it is producing. Upstream sources of GHG emissions will include those such emissions from fuel production and manufacture of the mining and process equipment. Upstream GHG emissions are not expected to exceed the threshold to require an assessment.

9 Net-Zero 2050 Plan

9.1 Net-Zero Approach to Mitigation

Canada Nickel's net-zero plan is designed based on the following three principles: (1) Avoid: prioritize the avoidance of emissions during design and engineering phases (i.e. the integration of BAT/BEP), (2) Reduce: continuously evaluate and assess further emission reductions based on the changing environment (i.e. the rapid evolvement of technology and economics), and (3) Offset: offsetting of residual sources of hard to abate emissions.

9.1.1 Avoiding emissions

The Project is being conceived with a strong commitment to using the best-in-class, feasible, low-emission equipment and processes as previously outlined. The Project is furthermore designed to use Ontario grid electricity for primary energy from the start of operations, with the potential for minimal use of diesel generators during construction of the required transmission line. By connecting to the Ontario electricity grid instead of self-generating electricity, a GHG emission reduction of 98% can be realized from primary energy demand, and a 59% GHG emission reduction from the Project's overall emissions taking into account operationally controlled emissions from fuel use, land conversion, blasting and acquired energy.

9.1.2 Reducing emissions

Canada Nickel will work to implement GHG reduction technologies and practices identified in the selected BAT/BEP and will evaluate the techno-economic potential of eliminated technologies and assess new emerging technologies for feasibility throughout the length of the Project, in consultation with relevant Project stakeholders. Canada Nickel will acknowledge non-binding, strategic advice and recommendations from relevant stakeholders on the Project, related to additional GHG emissions reduction opportunities, potential offsets, and general net-zero strategy.

As discussed in the BAT/BEP technical feasibility assessment (Section 6.1.1), certain technologies such as hydrogen-based electric mining equipment, may become technically feasible during the life of the Project, but are not currently considered a feasible option for a credible path to net-zero. The net-zero plan has been developed using a conservative approach consistent with best practice for GHG accounting, however as future cost reductions and advancements begin to create more favourable economic conditions for additional technologies, including a stable, clear, and consistent climate policy (i.e., price of carbon, robust offset credit system, carbon reduction incentive programs), Project emissions could be further reduced, lowering the carbon offsets to achieve net-zero.

9.1.3 Offsetting emissions

Remaining, hard-to-abate emissions will be offset with a priority for purchases of high-quality, credible carbon credits. The IPT Carbonation process described throughout the BAT/BEP assessment (Section 6) offers the potential to offset the cost of carbon credits with carbon storage fees for Ontario industrial emitters implementing point-source carbon capture. Preliminary studies indicate high demand for CO_2 storage capacity moving toward 2050, given the communicated price on carbon and Carbon Capture, Utilization, and Storage (CCUS) Investment Tax Credit (ITC) status, with approximately 50 potential industrial emitters concentrated in four distinct clusters in Sudbury, Sault Ste. Marie, Toronto and Sarnia (Ausenco 2023).

Additionally, sequestering carbon captured from DAC facilities could prove an alternative route to offsetting residual Project emissions as DAC technology matures. This route will be monitored by Canada Nickel for techno-economic feasibility throughout the length of the Project, including the potential opportunity for partnerships with leading DAC technology providers.

9.2 Selected Technologies and Practices

A summary of all potential GHG mitigation measures considered in the BAT/BEP assessment for inclusion in the net-zero plan can be found in Table 6.1 in Section 6.1.1.

Based on the BAT/BEP assessment, the technologies and approaches selected to be included in the Project's net-zero plan on the basis of technical feasibility, GHG reduction potential and economic feasibility are included in Table 6.6 of Section 6.1.6. Table 6.6 includes the reasoning for selection with respect to GHG reduction potential, a description of the level of maturity of the BAT/BEP and potential barriers to implementation. A list of the technologies excluded from the net-zero plan following the BAT/BEP assessment, including the reasoning for each exclusion, is also provided in Section 6.1.6.4.

A summary of the selected technologies by emission source to be included in the Project's net-zero plan is provided below:

- Carbon sinks
  - IPT Carbonation process
  - Passive mineral carbonation
- On-land equipment
  - Diesel powered
  - Battery-electric
  - Trolley-assist haulage
  - Autonomous equipment
- Primary energy
  - Ontario grid electricity

9.3 Emission Targets

The Project is being designed and constructed based on the best-available-technologies and best-environmental practice as identified in Section 6.1.6. As is evident from the net emissions in Section 9.5, at the peak of operations with the net-zero plan in place, the Project is estimated to have an emissions intensity of approximately 0.23 t CO_2e/t Ni Eq and the average emissions intensity over the Project operational lifetime is estimated to be 1.47 t CO_2e/t Ni Eq, which is lower than the industry average of 34 t CO_2e/t Ni Eq (Canada Nickel 2024).

Canada Nickel is committed to continuous improvement such that the Project GHG emissions are minimized throughout the life of the Project. This includes the review of potential GHG emissions over the life of the Project as identified mitigation technology and practices become technically and economically feasible, as well as socially acceptable.

9.4 Schedule for Implementation

The Project will be designed and constructed based on the best available technology and best environmental practice identified in Section 6.1.6. The mature technologies of trolley-assist haulage and grid electricity for primary energy are planned to be implemented fully during the operations stage of the Project, as well as all selected BEPs for energy consumption and GHG emission reductions. Based on technical and economic feasibility assessment (Ausenco 2023), as well as sourcing the CO_2, the IPT carbonation process is expected to be operational in year 1 of processing operations and provide carbon storage capacity until the end of Project operations.

The emerging technologies (i.e., battery electric on-land equipment and autonomous on-land equipment) are expected to be deployed in a rolling fashion as commercial implementation increases, with implementation of battery electric equipment autonomous equipment planned to initiate throughout the , with the goal of having complete fleet conversion by no later than 2050.

A preliminary schedule for implementing the selected technologies is provided in Table 9.1. The schedule is based on technological and economic data, assumptions and information outlined in the BAT/BEP assessment (Section 6). This schedule will be continuously evaluated and updated as necessary to support achievement of net-zero 2050 emissions in a technologically and economically feasible manner. Canada Nickel is committed to the continuous evaluation and assessment of emission reductions throughout the life of the Project. As part of the regular review of this net-zero plan and as best-practices continue to be refined on mitigation measures and opportunities, Canada Nickel is committed to continually updating its BAT/BEP assessment and implement additional emission reduction opportunities as they become feasible over time.

Canada Nickel will use regular reviews and monitoring of mitigation opportunities to make future decisions and investments aligned with the net-zero plan. Decision-making will be based on numerous factors including associated costs, technical challenges, risks, infrastructure requirements, global competitiveness, government policies and stakeholder and rights holder considerations.

Table 9.1 BAT Implementation Timeline

Technology	Year
Grid electricity	2027 - 2070
Trolley-assist haulage	2028
IPT Carbonation and passive mineral carbonation	2028
Battery-electric	2028 -2050
Autonomous equipment	2028 -2050

9.5 Net-Zero emissions

The estimated emissions profile for the Project, in line with the selected BAT/BEP and net-zero plan is provided on an annual basis in Table 9.2. Net emissions totals are in alignment with the BAT implementation timeline outlined in Table 9.1, with Canada Nickel planned to purchase offset credits to achieve net-zero by 2050 as per Section 9.1.3. The emissions reductions incorporated in the net-zero emissions profile do not include reductions associated with implementation of the IPT Carbonation process or passive mineral carbonation. Based on the Project Technical Feasibility Study (Ausenco, 2023) it is assumed that CO_2 for the IPT Carbonation process is sourced from industrial emitters and cannot be counted against net Project GHG emissions. Emissions reductions associated with passive mineral carbonation are currently excluded based on data availability.

The net emissions projection represents a conservative approach to net-zero 2050, assuming maximum implementation of selected BAT by the year 2050 and the purchase of carbon offset credits to offset residual emissions from 2050 onward. In reality, Canada Nickel will continuously evaluate current and emerging BAT as it relates to technological advancements, changing market conditions and relevant government policies, with the goal of promoting accelerated GHG reductions were technologically and economically feasible.

Table 9.2 Net GHG Emissions

Year	Direct GHG Emissions	Acquired Energy GHG Emissions	Avoided Domestic Emissions	Offset Credits	Net GHG Emissions	Emissions Intensity (Before Offsets)
	(t CO_2e/y)	(t CO_2e/y)	(t CO_2e/y)	(t CO_2e/y)	(t CO_2e/y)	(t CO_2e/ t Ni Eq)
2025	2,680,872	45			2,680,917	
2026	2,713,502	368			2,713,870	
2027	2,769,019	1,280			2,770,300	
2028	160,619	17,741			178,360	6.56
2029	163,775	19,890			183,665	5.44
2030	136,708	17,200			153,908	3.98
2031	168,633	23,115			191,748	3.75

Year	Direct GHG Emissions (t CO_2e/y)	Acquired Energy GHG Emissions (t CO_2e/y)	Avoided Domestic Emissions (t CO_2e/y)	Offset Credits (t CO_2e/y)	Net GHG Emissions (t CO_2e/y)	Emissions Intensity (Before Offsets) (t CO_2e/ t Ni Eq)
2032	192,962	29,349			222,311	3.14
2033	216,621	26,075			242,696	3.27
2034	192,602	20,981			213,583	3.60
2035	193,351	18,993			212,344	3.17
2036	161,873	17,916			179,788	2.41
2037	139,658	17,469			157,126	2.61
2038	137,562	16,562			154,124	2.97
2039	113,312	15,514			128,827	2.33
2040	107,301	15,423			122,724	1.89
2041	87,116	14,648			101,764	1.56
2042	81,192	13,934			95,126	1.80
2043	114,859	13,956			128,815	1.76
2044	67,785	12,722			80,506	1.09
2045	51,313	11,906			63,220	0.96
2046	42,623	11,123			53,747	0.78
2047	32,294	10,244			42,538	0.63
2048	25,358	9,852			35,210	0.53
2049	17,511	10,082			27,593	0.50
2050	12,596	11,263		23,859	-	0.42
2051	13,262	11,754		25,016	-	0.43
2052	13,738	12,334		26,072	-	0.43
2053	11,173	11,599		22,772	-	0.35
2054	10,220	11,178		21,398	-	0.28
2055	9,126	10,786		19,913	-	0.26
2056	8,156	10,676		18,833	-	0.23
2057	5,539	9,845		15,384	-	0.21
2058	2,106	8,546		10,652	-	0.20
2059	2,088	8,517		10,605	-	0.20
2060	2,088	8,495		10,583	-	0.31
2061	2,088	8,473		10,561	-	0.35
2062	2,088	8,478		10,566	-	0.35
2063	2,088	8,448		10,536	-	0.35
2064	2,088	8,452		10,540	-	0.35
2065	2,088	8,448		10,536	-	0.35

Year	Direct GHG Emissions (t CO_2e/y)	Acquired Energy GHG Emissions (t CO_2e/y)	Avoided Domestic Emissions (t CO_2e/y)	Offset Credits (t CO_2e/y)	Net GHG Emissions (t CO_2e/y)	Emissions Intensity (Before Offsets) (t CO_2e/ t Ni Eq)
2066	2,088	8,440		10,528	-	0.35
2067	2,088	8,431		10,518	-	0.35
2068	2,088	8,428		10,516	-	0.35
2069	1,228	706		1,935	-	0.87
2070	83	45		128	-	
2071	1,238	368		1,607	-	
2072	4,031	1,280		5,311	-	
Totals (Average Emissions Intensity)	**10,881,796**	**551,381**		**298,368**	**11,134,810**	**1.47**

9.6 GHG Legislation and Policies

The management of GHG emissions is subject to several statutes, policies, and frameworks. Table 9.3 provides a description of the key legislation, policy, and regulatory guidance documents applicable to the assessment of climate change.

Table 9.3 Summary of Key Legislation, Policy, and Regulatory Guidance Documents for Climate Change

Regulation or Policy	Description
Federal	
Canada's 2030 Emissions Reduction Plan (ECCC 2022)	A roadmap to reducing Canada wide GHG emissions 40% below 2005 levels by 2030 and reaching net-zero emissions by 2050.
Greenhouse Gas Reporting Program	Section 46 of the *Canadian Environmental Protection Act* requires GHG emissions to be reported via the GHG Reporting Program if facility emissions are greater than 10,000 tonnes CO_2e per year.
Strategic Assessment of Climate Change (ECCC 2020)	Provides a framework to establish whether a designated project will hinder or contribute to Canada's ability to meet its international GHG reduction commitments, and to help to achieve a net-zero economy by 2050. The SACC requires: • Estimation of GHG emissions for the Project • Estimation of GHGs from upstream activities (if applicable) • Review of best available technologies and best available practices • Assessment of climate change resilience • Credible plan to achieve net-zero emissions by 2050

Regulation or Policy	Description
Canadian Net Zero Emissions Accountability Act	Establishes five-year national emissions-reduction targets for 2030, 2035, 2040, and 2045. The plans developed to meet each target will explain how they contribute to Canada achieving net-zero emissions by 2050.
Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030 (ECCC 2021b)	Canada's minimum national price on carbon pollution for explicit price-based systems (i.e., systems that directly set a price on emissions) was $65 per tonne of GHG emissions calculated in carbon dioxide equivalent (CO_2e) in 2023, and will increase by $15 per year to $170 per tonne CO_2e by 2030.
Provincial	
Ontario Emissions Performance Standard (EPS)(O. Reg. 241/19)	As of January 1, 2022 facilities which emit greater than 50,000 tonnes of CO_2e per year are required to report their emissions under the EPS.
	Includes the industrial activity of producing metal or diamonds from the mining or milling of ore or kimberlite.
Greenhouse Gas Emissions: Quantification, Reporting and Verification Regulation (O.Reg. 390/18)	Requires facilities to report annual GHG emissions if they: • import greater than zero megawatt-hours of electricity per year • emit 10,000 tonnes or more of carbon dioxide equivalent (CO_2) per year • are registered, or required to register, under the EPS regulation

10 Project Impact on Federal and Global GHG Emissions

10.1 Impact on Canada's GHG Reduction Efforts

As part of Canada's 2030 emissions reduction plan, Canada has set a 2030 emissions reduction target of 40% below 2005 levels (ECCC 2022). This target represents approximately 443 Megatonnes CO_2e emissions Canada-wide in the year 2030. In the year 2030, with the implementation of the Project's net-zero plan, it is estimated that net annual GHG emissions from the Project would amount to 154 kilotonnes CO_2e, approximately 0.03% of Canada's 2030 emissions reduction target.

Canada's ultimate GHG target is to achieve net-zero emissions by 2050 (ECCC 2022). With the implementation of the Project's net-zero plan, it is estimated that in 2050, the Project's GHG emissions will amount to approximately 24 kilotonnes CO_2e. As part of the net-zero plan, carbon offsets will be purchased to offset remaining residual emissions post 2050, such that the Project is net-zero emissions, in alignment with Canada's target.

In addition to the proposed net-zero plan, Canada Nickel intends to implement a reduction in net Project GHG emissions with the sequestration of CO_2 through either passive mineralization or through the IPT carbonation process. With the implementation of the IPT Carbonation process, given an estimated average life of mine sequestration capacity of 1.3 Megatonnes CO_2 per annum (Canada Nickel 2024), the Project would be expected to provide a CO_2 sequestration capacity of approximately 54 Megatonnes CO_2 over the life of the Project. Through the IPT process, the added CO_2 storage capacity within Canada as a direct result of the Project proceeding may provide an opportunity for the Project to promote emissions reductions from other regulated emitters and have an overall positive impact on Canada-wide GHG emissions reduction targets.

10.2 Impact on Global GHG Emissions

Based on feasibility studies, the Project is expected to represent the third largest nickel sulphide operation globally (Canada Nickel 2024). As of 2023, the industry average carbon intensity of nickel production was estimated to be 34 t CO_2e/t Ni Eq, whereas based on the net-zero plan outlined in Section 9, the Project has the potential to operate with an average carbon intensity of 1.47 t CO_2e/ t Ni Eq, prior to purchasing of carbon offsets. This represents a decrease in carbon intensity relative to the industry average and given the technically feasible large scale production capacity of the Project, indicates the potential for the Project to have a positive impact on global GHG emissions associated with nickel production. This is especially important, given that the current global nickel supply growth is dominated by processes relying on conventional coal-powered nickel production in Indonesia, with large carbon intensities (i.e., 60 – 90 t CO_2e/tNi) (Canada Nickel 2024).

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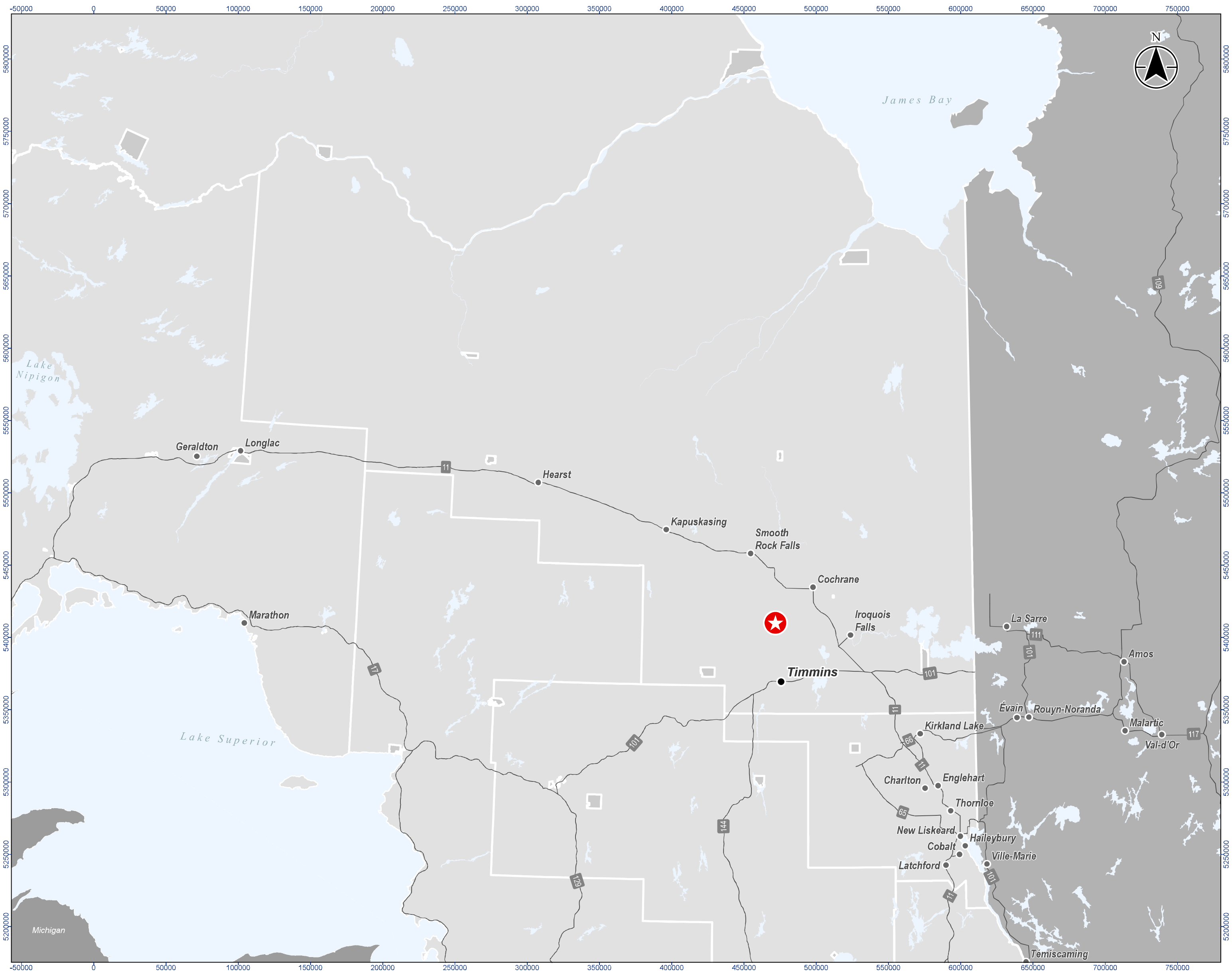
Appendices

Appendix A Figures



Legend

- Project Location
- Major Road
- Waterbody

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Notes

1. Coordinate System NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.

Project Location
Timmins, Ontario

160930456 REVA
Prepared by tcoghlan on 2024-09-11

Client/Project
Canada Nickel Company (CNC)
Crawford Nickel Project

Figure No.
A.1

Title
Project Location

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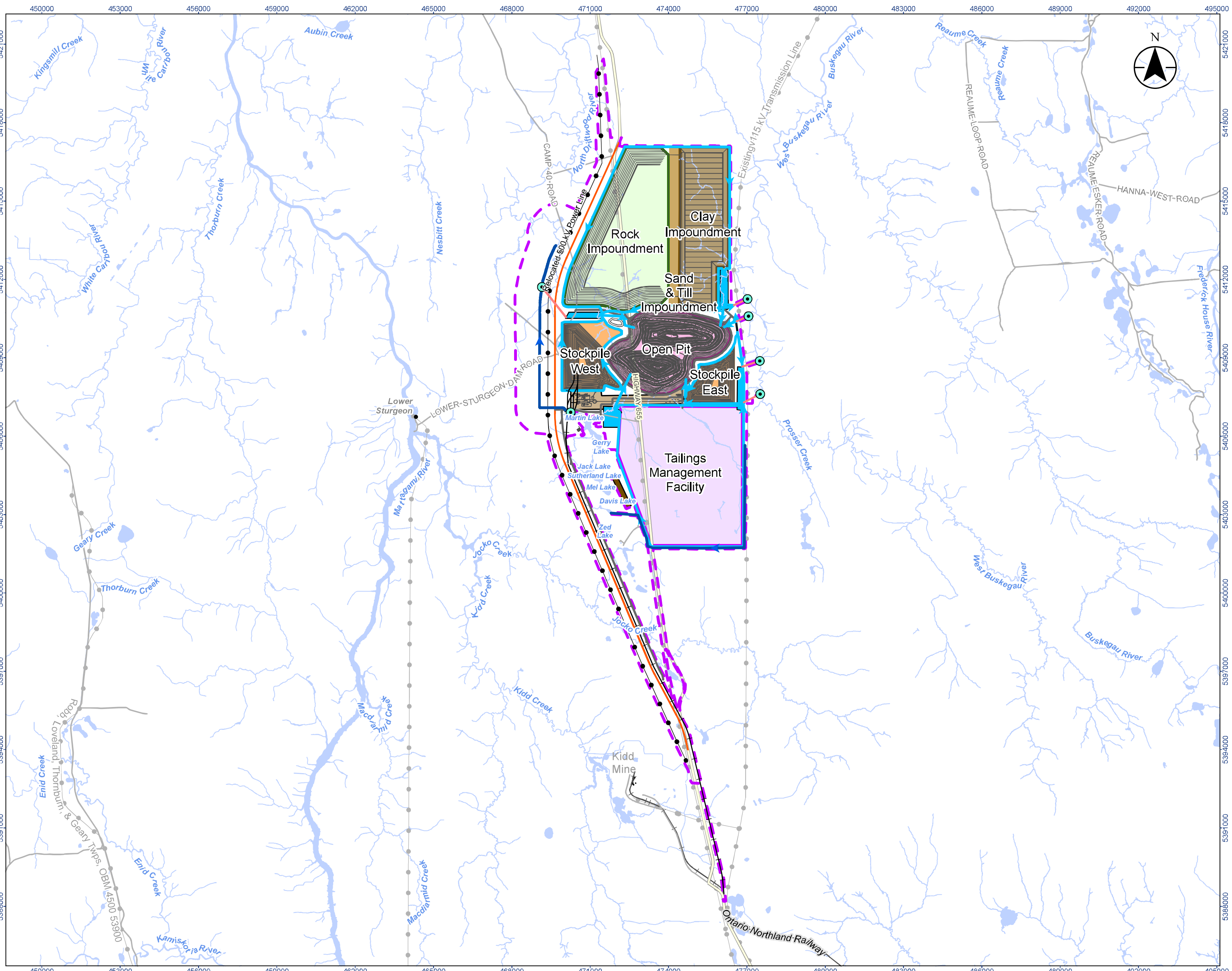

Legend

Project Area

Base Features

- Existing Major Road
- Existing Minor Road
- Railway
- Existing Transmission Line
- Unknown Pipeline
- Watercourse
- Waterbody

Ancilliary Infrastructure

- Relocated Hwy 655
- Rail Spur Line
- Transmission Line

Proposed Project Components

- Discharge Route
- Non-Contact Water Channel
- Contact Water Channel
- Site Road
- Discharge Location
- Ore Stockpile
- Open Pit
- Clay Impoundment
- Pond
- Tailings Management Facility
- Rock Impoundment
- Reclaim Stockpile
- Sand & Till Impoundment
- Process Plant Area

0 1 2 km

1:150,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.
3. The Project Components and baseline information on this figure are considered preliminary and may be further refined through the development of the Impact Statement based on feedback received from agencies, Indigenous peoples, the public, and project stakeholders.

Project Location
Timmins, Ontario

160930456 REVA
Prepared by tcoghlan on 2024-09-10

Client/Project
Canada Nickel Company (CNC)
Crawford Nickel Project

Figure No.
A.2

Title
Project Site Plan - Project Area

Appendix B Source Data from Canada Nickel

Crawford Nickel Project
Worksheet: energy_v2

This data from "Crawford IA mining data 20240125.xlsx". Data provided to Stantec by CNC on Jan. 25, 2024.

Crawford FS: Energy Consumption

Diesel	units	Total	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Drill1	000 litres	10,328	-	15	65	24	130	34	74	50	129	267	302	347	403	463
Blast	"	60,984	-	59	503	1,159	770	1,137	1,795	1,726	1,961	2,218	2,499	2,395	2,273	2,060
Ex1	"	29,828	-	972	2,357	2,958	2,996	2,714	1,950	2,293	2,544	1,549	904	1,089	769	1,893
Truck1	"	130,345	525	2,766	9,933	14,204	15,108	13,649	7,906	11,168	13,712	5,261	2,751	5,784	3,756	7,975
Truck2	"	198,619	-	3,345	4,765	7,243	14,618	13,308	15,560	17,250	14,552	15,100	7,804	3,517	4,882	13,665
Truck3	"	1,595,092	-	1,591	7,953	23,082	19,033	14,692	31,850	42,002	57,028	58,985	76,154	66,858	61,257	52,416
TD1	"	16,913	64	534	1,383	1,536	1,614	1,384	1,079	1,128	1,083	759	552	575	415	883
TD2	"	15,013	50	496	595	602	581	607	846	945	949	1,129	1,030	683	751	957
TD3	"	66,191	-	858	1,534	1,193	2,005	1,237	2,560	2,296	2,919	3,309	2,855	2,620	2,596	3,208
Grader	"	8,400	-	56	94	131	188	169	244	300	281	319	300	263	300	319
RT	"	5,177	-	-	234	234	205	117	117	117	117	205	234	234	234	234
FEL1	"	3,435	-	71	92	119	122	116	120	151	144	200	165	191	183	324
FEL2	"	7,309	-	141	184	350	366	260	447	411	415	417	399	398	451	378
FEL3	"	6,176	-	342	388	409	246	608	587	50	126	93	271	308	293	12
Tanker	"	23,143	-	165	498	1,053	1,076	864	937	1,074	1,239	1,223	1,220	1,268	1,201	1,140
UX	"	5,702	-	126	252	252	221	126	126	126	126	221	252	252	252	252
Mill Vehicles	"	37,778	-	-	-	511	511	511	732	953	953	953	953	953	953	953
Sub-Total Diesel	**000 litres**	**2,220,432**	**639**	**11,537**	**30,829**	**55,061**	**59,789**	**51,532**	**66,931**	**82,039**	**98,278**	**92,208**	**98,644**	**87,734**	**80,969**	**87,133**

Gasoline	units	Total	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Lighting Plants	000 litres	16,060	82	596	740	658	514	576	781	802	740	658	740	699	679	617
Mine Maintenance Vehicl	000 litres	8,049	4	153	256	277	288	281	270	284	299	263	238	245	234	277
Other Mine Light Vehicles	"	21,997	5	333	494	643	660	659	697	756	807	784	748	748	743	794
G&A Light Vehicles	"	16,571	-	104	139	396	396	396	396	396	396	396	396	396	396	396
Sub-Total Gasoline	**000 litres**	**62,677**	**91**	**1,187**	**1,628**	**1,974**	**1,858**	**1,911**	**2,144**	**2,238**	**2,242**	**2,101**	**2,122**	**2,088**	**2,051**	**2,084**

Electricity	units	Total	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Mining	MWhr	10,215,840	1,671	14,964	45,174	75,128	87,060	120,504	179,297	220,619	238,716	297,707	251,857	294,039	376,538	363,634
Concentrator	"	64,740,181	-	-	-	686,755	832,431	832,431	1,129,158	1,622,202	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200
G&A	"	93,273	-	1,627	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Sub-Total Electricity	**MWhr**	**75,049,294**	**1,671**	**16,591**	**47,343**	**764,053**	**921,660**	**955,104**	**1,310,624**	**1,844,991**	**1,894,086**	**1,953,076**	**1,907,226**	**1,949,408**	**2,031,907**	**2,019,003**

Power (avg Demand)	units	Max	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
Mining	MW	34	1	1	4	6	7	9	13	16	18	22	18	21	27	26
Concentrator	"	239	-	-	-	100	121	121	163	235	239	239	239	239	239	239
G&A	"	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Power	**MW**	**274**	**1**	**2**	**4**	**106**	**128**	**130**	**177**	**251**	**257**	**261**	**258**	**261**	**267**	**266**

Crawford Nickel Project
Worksheet: **energy_v2**

This data from "Crawford IA mining data 20240125.xlsx". Data

Crawford FS: Energy Consumption

Diesel	units	Total	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23
Drill1	000 litres	10,328	528	523	552	419	525	490	254	271	397	312	360	437
Blast	"	60,984	2,425	2,655	2,560	2,623	2,483	2,441	2,233	2,222	2,498	2,457	2,203	2,303
Ex1	"	29,828	692	278	239	743	151	528	1,696	415	100	-	-	-
Truck1	"	130,345	2,069	161	44	2,409	82	2,171	7,118	1,704	58	8	-	1
Truck2	"	198,619	10,920	6,470	4,696	3,850	9,354	2,914	5,193	10,597	3,901	413	338	469
Truck3	"	1,595,092	51,683	60,713	53,442	55,853	106,127	63,976	44,847	44,942	43,107	47,057	40,728	43,601
TD1	"	16,913	486	247	182	428	269	273	1,132	438	189	45	-	21
TD2	"	15,013	853	796	746	365	397	347	297	397	347	-	-	-
TD3	"	66,191	3,019	2,734	3,012	1,899	1,982	2,295	1,669	2,031	2,328	1,653	1,867	1,867
Grader	"	8,400	300	300	281	263	356	244	244	300	225	225	206	225
RT	"	5,177	234	234	234	234	234	205	117	117	117	117	117	117
FEL1	"	3,435	153	51	46	89	46	41	387	92	113	66	-	22
FEL2	"	7,309	360	350	350	124	112	119	76	63	54	45	47	56
FEL3	"	6,176	41	558	138	158	167	43	-	-	19	57	103	214
Tanker	"	23,143	864	918	954	766	707	634	380	394	338	266	291	329
UX	"	5,702	252	252	252	252	252	221	126	126	126	126	126	126
Mill Vehicles	"	37,778	953	953	953	953	953	953	953	953	953	953	953	953
Sub-Total Diesel	**000 litres**	**2,220,432**	**75,831**	**78,193**	**68,682**	**71,428**	**124,198**	**77,895**	**66,722**	**65,063**	**54,872**	**53,801**	**47,338**	**50,742**

Gasoline	units	Total	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23
Lighting Plants	000 litres	16,060	740	679	617	452	370	432	391	411	329	247	247	247
Mine Maintenance Vehicl	000 litres	8,049	241	220	220	234	230	230	252	241	216	205	205	205
Other Mine Light Vehicles	"	21,997	743	737	710	721	751	701	714	678	651	645	610	632
G&A Light Vehicles	"	16,571	396	396	396	396	396	396	396	396	396	396	396	396
Sub-Total Gasoline	**000 litres**	**62,677**	**2,120**	**2,031**	**1,942**	**1,803**	**1,747**	**1,759**	**1,753**	**1,726**	**1,591**	**1,493**	**1,458**	**1,480**

Electricity	units	Total	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23
Mining	MWhr	10,215,840	416,621	467,154	462,082	382,586	276,372	318,900	340,886	379,577	393,066	397,016	354,064	410,390
Concentrator	"	64,740,181	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200
G&A	"	93,273	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Sub-Total Electricity	**MWhr**	**75,049,294**	**2,071,990**	**2,122,523**	**2,117,451**	**2,037,955**	**1,931,741**	**1,974,269**	**1,996,255**	**2,034,946**	**2,048,435**	**2,052,385**	**2,009,433**	**2,065,759**

Power (avg Demand)	units	Max	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23
Mining	MW	34	30	34	33	28	20	23	24	27	28	28	25	29
Concentrator	"	239	239	239	239	239	239	239	239	239	239	239	239	239
G&A	"	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Power	**MW**	**274**	**270**	**273**	**273**	**267**	**260**	**262**	**264**	**267**	**268**	**268**	**265**	**269**

Crawford Nickel Project
Worksheet: energy_v2

This data from "Crawford IA mining data 20240125.xlsx". Data

Crawford FS: Energy Consumption

Diesel	units	Total	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35
Drill1	000 litres	10,328	426	535	436	348	331	416	464	-	-	-	-	-
Blast	"	60,984	2,476	2,589	1,881	1,560	1,272	1,103	447	-	-	-	-	-
Ex1	"	29,828	-	-	-	-	-	-	-	-	-	-	-	-
Truck1	"	130,345	-	1	-	-	-	-	-	13	-	-	-	-
Truck2	"	198,619	493	586	485	402	412	286	331	661	5	5	5	6
Truck3	"	1,595,092	53,425	73,895	55,863	46,869	39,153	61,588	55,369	3,004	3,440	3,453	3,288	4,048
TD1	"	16,913	-	21	-	-	-	-	-	43	-	-	-	-
TD2	"	15,013	-	-	-	-	-	-	-	198	-	-	-	-
TD3	"	66,191	1,867	1,867	1,724	1,582	1,582	1,154	869	-	-	-	-	-
Grader	"	8,400	244	281	244	225	169	150	113	75	75	75	75	75
RT	"	5,177	117	117	117	117	117	117	117	-	-	-	-	-
FEL1	"	3,435	-	22	-	-	-	-	-	195	-	-	-	-
FEL2	"	7,309	54	58	47	37	35	25	27	274	32	33	31	38
FEL3	"	6,176	452	494	-	-	-	-	-	-	-	-	-	-
Tanker	"	23,143	348	380	294	249	250	161	171	107	121	135	116	157
UX	"	5,702	126	126	126	126	126	126	126	-	-	-	-	-
Mill Vehicles	"	37,778	953	953	953	953	953	953	953	953	953	953	953	953
Sub-Total Diesel	**000 litres**	**2,220,432**	**60,982**	**81,927**	**62,170**	**52,468**	**44,401**	**66,079**	**58,986**	**5,524**	**4,627**	**4,654**	**4,468**	**5,278**

Gasoline	units	Total	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35
Lighting Plants	000 litres	16,060	247	247	288	411	411	247	165	-	-	-	-	-
Mine Maintenance Vehicl	000 litres	8,049	205	205	205	205	205	205	198	49	49	49	49	49
Other Mine Light Vehicles	"	21,997	656	678	621	586	556	551	508	68	59	59	59	59
G&A Light Vehicles	"	16,571	396	396	396	396	396	396	396	396	396	396	396	396
Sub-Total Gasoline	**000 litres**	**62,677**	**1,504**	**1,525**	**1,510**	**1,598**	**1,568**	**1,399**	**1,266**	**512**	**504**	**504**	**504**	**504**

Electricity	units	Total	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35
Mining	MWhr	10,215,840	461,633	479,450	424,089	384,632	343,313	215,908	79,710	71,517	69,921	65,358	61,676	58,817
Concentrator	"	64,740,181	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200
G&A	"	93,273	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169	2,169
Sub-Total Electricity	**MWhr**	**75,049,294**	**2,117,003**	**2,134,819**	**2,079,458**	**2,040,001**	**1,998,682**	**1,871,277**	**1,735,079**	**1,726,886**	**1,725,290**	**1,720,727**	**1,717,045**	**1,714,186**

Power (avg Demand)	units	Max	Yr 24	Yr 25	Yr 26	Yr 27	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35
Mining	MW	34	33	34	30	28	25	16	6	5	5	5	4	4
Concentrator	"	239	239	239	239	239	239	239	239	239	239	239	239	239
G&A	"	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Power	**MW**	**274**	**273**	**274**	**270**	**267**	**264**	**255**	**245**	**245**	**244**	**244**	**244**	**244**

Crawford Nickel Project
Worksheet: energy_v2

This data from "Crawford IA mining data 20240125.xlsx". Data

Crawford FS: Energy Consumption

Diesel	units	Total	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42
Drill1	000 litres	10,328	-	-	-	-	-	-	-
Blast	"	60,984	-	-	-	-	-	-	-
Ex1	"	29,828	-	-	-	-	-	-	-
Truck1	"	130,345	-	-	-	-	1	4	2
Truck2	"	198,619	5	6	6	6	28	84	82
Truck3	"	1,595,092	3,184	3,826	3,990	3,978	3,822	3,811	109
TD1	"	16,913	-	-	-	-	21	86	43
TD2	"	15,013	-	-	-	-	-	-	50
TD3	"	66,191	-	-	-	-	-	-	-
Grader	"	8,400	75	75	75	75	75	75	19
RT	"	5,177	-	-	-	-	-	-	-
FEL1	"	3,435	-	-	-	-	19	65	29
FEL2	"	7,309	30	36	38	38	36	36	29
FEL3	"	6,176	-	-	-	-	-	-	-
Tanker	"	23,143	112	149	166	163	122	142	1
UX	"	5,702	-	-	-	-	-	-	-
Mill Vehicles	"	37,778	953	953	953	953	953	953	238
Sub-Total Diesel	**000 litres**	**2,220,432**	**4,359**	**5,045**	**5,228**	**5,213**	**5,078**	**5,256**	**600**

Gasoline	units	Total	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42
Lighting Plants	000 litres	16,060	-	-	-	-	-	-	-
Mine Maintenance Vehicl	000 litres	8,049	49	49	49	49	49	49	16
Other Mine Light Vehicles	"	21,997	59	59	59	59	59	59	18
G&A Light Vehicles	"	16,571	396	396	396	396	396	396	99
Sub-Total Gasoline	**000 litres**	**62,677**	**504**	**504**	**504**	**504**	**504**	**504**	**132**

Electricity	units	Total	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42
Mining	MWhr	10,215,840	57,087	54,604	52,876	51,393	50,004	48,725	19,504
Concentrator	"	64,740,181	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	1,653,200	122,005
G&A	"	93,273	2,169	2,169	2,169	2,169	2,169	2,169	542
Sub-Total Electricity	**MWhr**	**75,049,294**	**1,712,456**	**1,709,974**	**1,708,245**	**1,706,762**	**1,705,373**	**1,704,094**	**142,051**

Power (avg Demand)	units	Max	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42
Mining	MW	34	4	4	4	4	4	3	2
Concentrator	"	239	239	239	239	239	239	239	71
G&A	"	0	0	0	0	0	0	0	0
Sub-Total Power	**MW**	**274**	**244**	**243**	**243**	**243**	**243**	**243**	**73**

Crawford Nickel Project
Worksheet: AppB2_CNC_Plant_Physicals

This data from "Crawford IA mining data 20240125.xlsx". Data provided to Stantec by CNC on Jan. 25, 2024.

Crawford FS: Mine Plan Physicals

Processing Summary

Payable Metal	units	Total	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Payable Ni	000 lbs	3,129,823	-	-	-	41,893	48,867	59,348	77,439	106,575	111,697	80,668	97,066	113,105	85,315	66,394	72,817
Payable Co	000 lbs	32,393	-	-	-	173	410	1,135	1,432	1,765	2,157	1,011	1,726	2,069	622	541	540
Payable Fe	000 tonnes	29,067	-	-	-	262	392	373	514	737	757	791	751	750	753	787	810
Payable Cr	000 lbs	3,959,453	-	-	-	44,270	59,153	55,282	74,539	105,809	109,521	108,007	108,984	108,421	106,545	103,099	105,332
Payable Pd	000 oz	282	-	-	-	3	3	5	8	10	12	7	10	9	6	7	6
Payable Pt	000 oz	86	-	-	-	2	1	1	2	2	2	2	2	2	2	2	2
Payable NiEq	000 lbs	4,961,111	-	-	-	59,960	74,468	85,286	112,669	156,231	163,812	130,647	147,719	164,156	132,808	114,343	121,979

Blasting

Blasting	units	Total	Yr -3	Yr -2	Yr -1	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12
Total Blasted	000 tonnes	5,081,580	-	4,200	36,726	85,814	58,216	87,293	148,370	152,130	169,185	191,530	213,304	209,629	202,129	174,920	205,799
Blasting Days	days	4,063	-	33	130	130	130	130	130	130	130	130	130	130	130	130	130
Tonnes Blasted per Day	000 tonnes	1,251	-	127	283	660	448	671	1,141	1,170	1,301	1,473	1,641	1,613	1,555	1,346	1,583
Bulk Explosives Consumed	tonnes	1,244,580	-	1,195	10,263	23,660	15,711	23,207	36,640	35,221	40,011	45,267	50,998	48,881	46,380	42,031	49,480
Total Boosters	tonnes	1,817	-	3	24	43	32	49	64	48	65	74	81	68	59	65	72
Explosives per Blasting Day	tonnes	307	-	36	79	182	121	179	282	271	308	349	393	377	357	324	381
Total Blastholes Blasted	number	3,099,179	-	8,680	67,441	105,580	77,398	138,570	142,766	66,261	127,732	148,363	159,577	104,618	67,970	119,323	115,063
Pioneer	number	194,121	-	2,317	10,358	3,773	20,706	5,439	11,283	7,614	16,683	15,878	7,307	1,935	2,002	11,635	13,053
7.5m Bench	number	1,574,399	-	6,363	57,083	91,283	47,890	132,980	106,684	13,148	73,841	92,298	107,252	45,572	2,061	65,648	45,038
15m Bench	number	1,330,659	-	-	-	10,523	8,803	151	24,799	45,498	37,208	40,188	45,018	57,111	63,907	42,040	56,972
Blastholes Drilled per Day	number		-	95	185	318	220	381	401	238	350	406	437	292	220	327	315
Pioneer	number		-	25	28	10	57	15	41	42	46	44	20	11	22	32	36
7.5m Bench	number		-	70	156	250	131	364	292	72	202	253	294	125	23	180	123
15m Bench	number		-	-	-	58	32	2	68	125	102	110	123	156	175	115	156
Blastholes Blasted per Blast	number		-	263	519	812	595	1,066	1,098	510	983	1,141	1,228	805	523	918	885
Pioneer	number		-	70	80	29	159	42	87	59	128	122	56	15	15	89	100
7.5m Bench	number		-	193	439	702	368	1,023	821	101	568	710	825	351	16	505	346
15m Bench	number		-	-	-	81	68	1	191	350	286	309	346	439	492	323	438
Pre-Split Holes Drilled	number	544,660	-	-	-	-	-	-	200	116	1,448	9,988	15,304	20,024	23,356	23,340	26,648
Total Pre-Split Packaged Explosive:	tonnes	6,808	-	-	-	-	-	-	3	1	18	125	191	250	292	292	333
Pre-Split Blasted per Blast	tonnes	1.68	-	-	-	-	-	-	0.02	0.01	0.14	0.96	1.47	1.93	2.25	2.24	2.56

Crawford Nickel Project
Worksheet: **AppB2_CNC_Plant_Physical**

This data from "Crawford IA mining data 20240125.xlsx". Data pr

Crawford FS: Mine Plan Physicals

Processing Summary

Payable Metal	units	Total	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27
Payable Ni	000 lbs	3,129,823	93,137	94,776	66,632	109,230	110,308	94,436	101,845	98,425	96,250	72,139	75,008	78,826	82,968	91,600	117,030
Payable Co	000 lbs	32,393	1,271	1,678	452	1,893	1,854	450	555	615	711	378	394	369	389	468	837
Payable Fe	000 tonnes	29,067	799	770	850	805	803	809	785	795	788	839	827	816	825	799	725
Payable Cr	000 lbs	3,959,453	104,356	100,216	105,050	104,720	107,495	116,310	116,563	114,784	114,186	108,611	108,548	110,299	113,510	112,609	115,882
Payable Pd	000 oz	282	7	9	5	8	10	4	6	7	6	5	4	4	4	7	14
Payable Pt	000 oz	86	2	2	2	2	3	1	2	2	2	2	1	1	1	3	5
Payable NiEq	000 lbs	4,961,111	143,293	144,210	116,674	160,929	162,729	144,963	152,215	149,035	146,605	122,317	124,726	128,380	133,430	141,706	167,346

Blasting

Blasting	units	Total	Yr 13	Yr 14	Yr 15	Yr 16	Yr 17	Yr 18	Yr 19	Yr 20	Yr 21	Yr 22	Yr 23	Yr 24	Yr 25	Yr 26	Yr 27
Total Blasted	000 tonnes	5,081,580	220,915	201,466	207,642	208,599	198,686	191,902	192,180	203,071	199,661	186,311	189,459	200,229	210,452	156,124	132,208
Blasting Days	days	4,063	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
Tonnes Blasted per Day	000 tonnes	1,251	1,699	1,550	1,597	1,605	1,528	1,476	1,478	1,562	1,536	1,433	1,457	1,540	1,619	1,201	1,017
Bulk Explosives Consumed	tonnes	1,244,580	54,175	52,255	53,524	50,672	49,824	45,563	45,347	50,988	50,143	44,952	47,002	50,534	52,840	38,394	31,839
Total Boosters	tonnes	1,817	76	84	79	67	82	61	62	85	78	55	58	62	65	47	39
Explosives per Blasting Day	tonnes	307	417	403	412	390	384	351	349	393	386	346	362	389	407	296	245
Total Blastholes Blasted	number	3,099,179	117,203	170,901	147,045	86,901	174,466	85,613	87,822	181,308	156,565	61,635	63,981	68,527	71,791	52,478	43,828
Pioneer	number	194,121	6,378	13,364	235	9,002	7,810	3,313	10,788	13,246	-	-	-	-	-	-	-
7.5m Bench	number	1,574,399	47,999	113,569	96,473	11,453	128,955	25,508	19,466	129,118	114,718	-	-	-	-	-	-
15m Bench	number	1,330,659	62,825	43,968	50,337	66,446	37,700	56,792	57,567	38,945	41,847	61,635	63,981	68,527	71,791	52,478	43,828
Blastholes Drilled per Day	number		321	468	403	238	485	235	241	497	429	169	175	188	197	144	120
Pioneer	number		17	37	1	25	29	9	30	36	-	-	-	-	-	-	-
7.5m Bench	number		132	311	264	31	353	70	53	354	314	-	-	-	-	-	-
15m Bench	number		172	120	138	182	103	156	158	107	115	169	175	188	197	144	120
Blastholes Blasted per Blast	number		902	1,315	1,131	668	1,342	659	676	1,395	1,204	474	492	527	552	404	337
Pioneer	number		49	103	2	69	60	25	83	102	-	-	-	-	-	-	-
7.5m Bench	number		369	874	742	88	992	196	150	993	882	-	-	-	-	-	-
15m Bench	number		483	338	387	511	290	437	443	300	322	474	492	527	552	404	337
Pre-Split Holes Drilled	number	544,660	28,872	28,000	24,984	28,032	26,384	13,936	12,180	18,776	18,672	21,516	26,100	25,480	32,000	26,048	20,828
Total Pre-Split Packaged Explosive:	tonnes	6,808	361	350	312	350	330	174	152	235	233	269	326	319	400	326	260
Pre-Split Blasted per Blast	tonnes	1.68	2.78	2.69	2.40	2.70	2.54	1.34	1.17	1.81	1.80	2.07	2.51	2.45	3.08	2.50	2.00

Crawford Nickel Project
Worksheet: **AppB2_CNC_Plant_Physical**

This data from "Crawford IA mining data 20240125.xlsx". Data pr

Crawford FS: Mine Plan Physicals

Processing Summary

Payable Metal	units	Total	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42	Yr 43
Payable Ni	000 lbs	3,129,823	121,133	132,644	116,889	65,130	65,130	36,987	30,731	30,731	30,731	30,731	30,731	30,731	30,731	30,731	2,268	-
Payable Co	000 lbs	32,393	1,023	1,368	773	376	376	300	283	283	283	283	283	283	283	283	21	-
Payable Fe	000 tonnes	29,067	723	707	740	867	867	644	595	595	595	595	595	595	595	595	44	-
Payable Cr	000 lbs	3,959,453	116,066	115,561	111,064	105,234	105,234	78,375	72,558	72,558	72,558	72,558	72,558	72,558	72,558	72,558	5,355	-
Payable Pd	000 oz	282	13	8	3	4	4	6	7	7	7	7	7	7	7	7	1	-
Payable Pt	000 oz	86	4	2	1	2	2	2	2	2	2	2	2	2	2	2	0	-
Payable NiEq	000 lbs	4,961,111	171,343	181,992	164,625	115,608	115,608	75,100	66,165	66,165	66,165	66,165	66,165	66,165	66,165	66,165	4,883	-

Blasting

Blasting	units	Total	Yr 28	Yr 29	Yr 30	Yr 31	Yr 32	Yr 33	Yr 34	Yr 35	Yr 36	Yr 37	Yr 38	Yr 39	Yr 40	Yr 41	Yr 42	Yr 43
Total Blasted	000 tonnes	5,081,580	109,198	95,136	39,096	-	-	-	-	-	-	-	-	-	-	-	-	-
Blasting Days	days	4,063	130	130	130	-	-	-	-	-	-	-	-	-	-	-	-	-
Tonnes Blasted per Day	000 tonnes	1,251	840	732	301	-	-	-	-	-	-	-	-	-	-	-	-	-
Bulk Explosives Consumed	tonnes	1,244,580	25,950	22,510	9,123	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Boosters	tonnes	1,817	32	28	11	-	-	-	-	-	-	-	-	-	-	-	-	-
Explosives per Blasting Day	tonnes	307	200	173	70	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Blastholes Blasted	number	3,099,179	35,873	31,193	12,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Pioneer	number	194,121	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.5m Bench	number	1,574,399	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15m Bench	number	1,330,659	35,873	31,193	12,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Blastholes Drilled per Day	number		98	85	35	-	-	-	-	-	-	-	-	-	-	-	-	-
Pioneer	number		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.5m Bench	number		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15m Bench	number		98	85	35	-	-	-	-	-	-	-	-	-	-	-	-	-
Blastholes Blasted per Blast	number		276	240	98	-	-	-	-	-	-	-	-	-	-	-	-	-
Pioneer	number		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.5m Bench	number		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15m Bench	number		276	240	98	-	-	-	-	-	-	-	-	-	-	-	-	-
Pre-Split Holes Drilled	number	544,660	19,820	24,880	27,728	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Pre-Split Packaged Explosive	tonnes	6,808	248	311	347	-	-	-	-	-	-	-	-	-	-	-	-	-
Pre-Split Blasted per Blast	tonnes	1.68	1.91	2.39	2.67	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C GHG Emissions Inventory

Crawford Nickel Project
Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	Year							
				-3	-2	-1	1	2	3	4	5
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	639.19	11,536.61	30,828.83	55,060.71	59,789.25	51,531.73	66,930.99	82,039.29
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	1,713.34	30,923.87	82,636.69	147,590.22	160,265.08	138,130.82	179,408.53	219,906.33
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	0.05	0.84	2.25	4.02	4.36	3.76	4.89	5.99
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	0.15	2.62	7.00	12.50	13.57	11.70	15.19	18.62
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	1,753.10	31,641.44	84,554.21	151,014.94	163,983.91	141,336.04	183,571.57	225,009.09

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Canada Nickel on Jan. 25, 2024.*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	Year							
				-3	-2	-1	1	2	3	4	5
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	91.25	1,186.82	1,628.45	1,973.59	1,858.00	1,911.14	2,143.77	2,238.14
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	210.55	2,738.34	3,757.32	4,553.67	4,286.96	4,409.57	4,946.33	5,164.05
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.01	0.09	0.12	0.14	0.14	0.14	0.16	0.16
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	210.90	2,742.97	3,763.67	4,561.37	4,294.21	4,417.03	4,954.68	5,172.78

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Canada Nickel on Jan. 25, 2024.*

Crawford Nickel Project
Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	6	7	8	9	10	11	12	13
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	98,277.56	92,208.37	98,644.48	87,734.34	80,969.00	87,132.77	75,831.20	78,192.80
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	263,433.01	247,164.53	264,416.54	235,171.89	217,037.40	233,559.38	203,265.53	209,595.80
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	7.17	6.73	7.20	6.40	5.91	6.36	5.54	5.71
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	22.31	20.93	22.39	19.92	18.38	19.78	17.21	17.75
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	269,545.78	252,899.80	270,552.13	240,628.88	222,073.59	238,978.95	207,982.16	214,459.32

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	6	7	8	9	10	11	12	13
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	2,242.15	2,100.94	2,121.55	2,087.62	2,050.86	2,083.67	2,119.75	2,031.06
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	5,173.30	4,847.51	4,895.04	4,816.76	4,731.94	4,807.64	4,890.89	4,686.26
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	5,182.04	4,855.70	4,903.31	4,824.90	4,739.94	4,815.77	4,899.15	4,694.17

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Crawford Nickel Project

Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	14	15	16	17	18	19	20	21
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	68,681.53	71,428.12	124,198.24	77,894.88	66,721.89	65,063.12	54,871.52	53,800.62
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	184,100.83	191,463.08	332,913.37	208,797.22	178,848.02	174,401.69	147,083.11	144,212.57
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	5.01	5.21	9.07	5.69	4.87	4.75	4.01	3.93
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	15.59	16.21	28.19	17.68	15.15	14.77	12.46	12.21
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	188,372.75	195,905.84	340,638.38	213,642.21	182,998.06	178,448.55	150,496.07	147,558.92

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	14	15	16	17	18	19	20	21
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	1,942.37	1,803.06	1,746.91	1,758.65	1,752.62	1,725.93	1,591.48	1,493.03
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	4,481.62	4,160.20	4,030.64	4,057.73	4,043.82	3,982.25	3,672.03	3,444.87
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.14	0.13	0.13	0.13	0.13	0.13	0.12	0.11
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	4,489.20	4,167.23	4,037.45	4,064.58	4,050.66	3,988.98	3,678.23	3,450.69

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Crawford Nickel Project
Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	22	23	24	25	26	27	28	29
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	47,338.49	50,742.17	60,981.79	81,927.26	62,170.39	52,468.22	44,400.71	66,079.36
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	126,890.82	136,014.39	163,461.70	219,606.01	166,647.72	140,641.07	119,016.11	177,125.72
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	3.46	3.70	4.45	5.98	4.54	3.83	3.24	4.82
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	10.75	11.52	13.84	18.60	14.11	11.91	10.08	15.00
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	129,835.22	139,170.50	167,254.71	224,701.80	170,514.66	143,904.54	121,777.79	181,235.79

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	22	23	24	25	26	27	28	29
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	1,457.93	1,479.53	1,503.83	1,525.43	1,509.86	1,598.13	1,568.43	1,398.53
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	3,363.88	3,413.72	3,469.78	3,519.62	3,483.69	3,687.38	3,618.85	3,226.83
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.11	0.11	0.11	0.11	0.11	0.12	0.11	0.10
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	3,369.56	3,419.49	3,475.65	3,525.57	3,489.58	3,693.61	3,624.96	3,232.28

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Crawford Nickel Project
Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	30	31	32	33	34	35	36	37
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	58,985.97	5,523.73	4,627.03	4,654.28	4,468.35	5,277.82	4,358.82	5,045.24
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	158,111.90	14,806.35	12,402.75	12,475.80	11,977.42	14,147.20	11,683.82	13,523.76
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	4.31	0.40	0.34	0.34	0.33	0.39	0.32	0.37
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	13.39	1.25	1.05	1.06	1.01	1.20	0.99	1.15
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	161,780.76	15,149.92	12,690.54	12,765.29	12,255.35	14,475.47	11,954.93	13,837.57

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	30	31	32	33	34	35	36	37
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	1,265.88	512.30	504.20	504.20	504.20	504.20	504.20	504.20
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	2,920.76	1,182.04	1,163.35	1,163.35	1,163.35	1,163.35	1,163.35	1,163.35
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.09	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	2,925.69	1,184.03	1,165.31	1,165.31	1,165.31	1,165.31	1,165.31	1,165.31

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Crawford Nickel Project

Worksheet: **Direct Emissions - Fuel**

Direct - Scope 1: Mobile Diesel

Category	Parameter	Units	Total Project	38	39	40	41	42	43
Mining Equipment and Vehicles	Fuel consumption - Diesel	kL	2,220,432	5,227.81	5,213.11	5,078.03	5,255.90	600.49	-
Mining Equipment and Vehicles	CO_2 Emissions	t	5,951,867.97	14,013.13	13,973.75	13,611.65	14,088.45	1,609.62	-
Mining Equipment and Vehicles	CH_4 Emissions	t	162.09	0.38	0.38	0.37	0.38	0.04	-
Mining Equipment and Vehicles	N_2O Emissions	t	504.04	1.19	1.18	1.15	1.19	0.14	-
Mining Equipment and Vehicles	GHG Total - Diesel	t CO_2e	6,089,976.62	14,338.30	14,298.00	13,927.50	14,415.36	1,646.97	-

Diesel volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Direct - Scope 1: Mobile Gasoline

Category	Parameter	Units	Total Project	38	39	40	41	42	43
Mining Equipment and Vehicles	Fuel consumption - Gasoline	kL	62,677	504.20	504.20	504.20	504.20	132.35	-
Mining Equipment and Vehicles	CO_2 Emissions	t	144,614.66	1,163.35	1,163.35	1,163.35	1,163.35	305.37	-
Mining Equipment and Vehicles	CH_4 Emissions	t	4.58	0.04	0.04	0.04	0.04	0.01	-
Mining Equipment and Vehicles	N_2O Emissions	t	0.44	0.00	0.00	0.00	0.00	0.00	-
Mining Equipment and Vehicles	GHG Total - Gasoline	t CO_2e	144,859.04	1,165.31	1,165.31	1,165.31	1,165.31	305.89	-

Gasoline volume source: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Ca*

Crawford Nickel Project
Worksheet: **Direct Emissions - Blasting**

Direct - Scope 1: Blasting

Data Sources
Explosives tonnes: *"Crawford IA mining data 20240125.xlsx" Provided to Stantec by Canada Nickel on Jan. 25, 2024.*

Year	Bulk Explosives Consumed (t)	Total Boosters (t)	Total Pre-Split Packaged Explosives (t)	GHG Total - Blasting (t CO_2e)
Explosives/Emulsion Type	Titan XL 1000 or Titan SME	Trojan Spartan 450 g	Dynosplit EX 32x26	
-3	-	-	-	-
-2	1,194.64	3.04	-	209.08
-1	10,262.55	23.60	-	1,793.18
1	23,659.94	42.74	-	4,120.24
2	15,711.33	31.93	-	2,740.25
3	23,206.73	48.58	-	4,049.23
4	36,640.07	63.61	2.50	6,378.37
5	35,220.82	48.22	1.45	6,115.66
6	40,010.90	65.17	18.10	6,964.86
7	45,267.45	74.03	124.85	7,912.70
8	50,998.37	80.61	191.30	8,926.90
9	48,880.70	68.03	250.30	8,566.07
10	46,380.27	58.94	291.95	8,138.16
11	42,030.77	64.89	291.75	7,397.05
12	49,480.11	71.61	333.10	8,699.17
13	54,175.49	75.57	360.90	9,520.13
14	52,255.07	84.00	350.00	9,196.43
15	53,523.51	79.15	312.30	9,397.12
16	50,672.32	66.96	350.40	8,904.09
17	49,823.77	81.80	329.80	8,769.35
18	45,563.08	61.20	174.20	7,963.67
19	45,347.43	62.40	152.25	7,921.18
20	50,987.56	84.88	234.70	8,943.60
21	50,142.71	77.81	233.40	8,789.50
22	44,951.92	55.47	268.95	7,881.22
23	47,001.67	57.58	326.25	8,254.10
24	50,533.92	61.67	318.50	8,864.09
25	52,840.13	64.61	400.00	9,289.60
26	38,393.93	47.23	325.60	6,761.08
27	31,839.43	39.45	260.35	5,604.17
28	25,949.98	32.29	247.75	4,578.77
29	22,509.58	28.07	311.00	4,001.69
30	9,123.49	11.44	346.60	1,690.61
31	-	-	-	-
32	-	-	-	-
33	-	-	-	-
34	-	-	-	-
35	-	-	-	-
36	-	-	-	-
37	-	-	-	-
38	-	-	-	-
39	-	-	-	-
40	-	-	-	-
41	-	-	-	-
42	-	-	-	-
43				
Total	1,244,580	1,817	6,808	218,341

Crawford Nickel Project
Worksheet: **Direct Emissions - LUC**

Project Area: **>100 ha**

Methodology: Following the logic of the SACC Technical Guide (2021)

Details: Analysis conducted in spreadsheet "Land Use Change_Tier1&2_20240214"

Emissions from Land Use Change

Year	LUC GHG Total (tCO2e)
-3	2,668,377.51
-2	2,668,377.51
-1	2,668,377.51
1	922.44
2	922.44
3	922.44
4	922.44
5	922.44
6	922.44
7	922.44
8	922.44
9	922.44
10	922.44
11	922.44
12	922.44
13	922.44
14	922.44
15	922.44
16	922.44
17	922.44
18	922.44
19	922.44
20	922.44
21	922.44
22	922.44
23	922.44
24	922.44
25	922.44
26	922.44
27	922.44
28	922.44
29	922.44
30	922.44
31	922.44
32	922.44
33	922.44
34	922.44
35	922.44
36	922.44
37	922.44
38	922.44
39	922.44
40	922.44
41	922.44
42	922.44
43	-
Total	**8,043,875.02**

Crawford Nickel Project
Worksheet: **AEE Scope 2**

Indirect - Scope 2
Data Sources

Purchased Electricity (GWh)	*"Crawford IA mining data (hard).xlsx". Data provided to Stantec by CNC on Dec. 30, 2023*	
Emission Factor ($t\ CO_2e/GWh$)	ECCC Data Catalogue	As per Section 2.1.2.1 of the SACC Technical Guide (2021) To quantify annual GHG emissions from acquired electricity, the proponent can use projected provincial emission intensities for electrical utilities, developed by ECCC. Emission intensity (EI) projections developed in 2020 are provided in Annex C of this guide. The annual update to EI projections are expected to be available in the open data tables of Canada's Greenhouse Gas Emissions Projections webpage17 but are not available at the time of publication of this document. To account for differences in electricity generation between the provincial average electricity generation mix for Ontario and the electricity generation mix planned to service the Project in Northeastern Ontario, the ECCC Ontario average emission factors were adjusted based on the percent of natural gas based electricity generation in Northeastern Ontario (IESO 2022a) relative to the average percent of natural gas based electricity generation for the province of Ontario (IESO 2022b) as of 2022. Natural gas represents the major direct GHG emitting electricity generation activity for the Province of Ontario with the rest of electricity generation capacity represented by solar, wind, hydroelectric and nuclear, and a minor amount of biofuel generation (i.e., less than 1%)

Year	Project Year	Purchased Electricity (GWh)	Emission Factor (t CO2e/GWh)	Emissions ($t\ CO_2e$)
2025	-3	1.67	26.88	44.93
2026	-2	16.59	22.20	368.33
2027	-1	47.34	27.04	1,280.26
2028	1	764.05	23.22	17,741.30
2029	2	921.66	21.25	19,580.83
2030	3	955.10	17.55	16,762.42
2031	4	1,310.62	17.01	22,292.25
2032	5	1,844.99	15.26	28,149.09
2033	6	1,894.09	12.96	24,554.36
2034	7	1,953.08	10.07	19,658.07
2035	8	1,907.23	9.17	17,495.62
2036	9	1,949.41	8.47	16,516.54
2037	10	2,031.91	7.93	16,115.28
2038	11	2,019.00	7.45	15,048.30
2039	12	2,071.99	6.85	14,189.30
2040	13	2,122.52	6.59	13,994.50
2041	14	2,117.45	6.31	13,354.06
2042	15	2,037.95	6.15	12,528.14
2043	16	1,931.74	5.92	11,444.49
2044	17	1,974.27	5.64	11,130.49
2045	18	1,996.26	5.29	10,555.01
2046	19	2,034.95	4.84	9,852.16
2047	20	2,048.44	4.49	9,199.75
2048	21	2,052.39	4.30	8,825.26
2049	22	2,009.43	4.52	9,088.59
2050	23	2,065.76	4.87	10,067.13
2051	24	2,117.00	4.87	10,316.86
2052	25	2,134.82	4.87	10,403.69
2053	26	2,079.46	4.87	10,133.89
2054	27	2,040.00	4.87	9,941.61
2055	28	1,998.68	4.87	9,740.24
2056	29	1,871.28	4.87	9,119.36
2057	30	1,735.08	4.87	8,455.62
2058	31	1,726.89	4.87	8,415.69
2059	32	1,725.29	4.87	8,407.91
2060	33	1,720.73	4.87	8,385.68
2061	34	1,717.05	4.87	8,367.73
2062	35	1,714.19	4.87	8,353.80
2063	36	1,712.46	4.87	8,345.37
2064	37	1,709.97	4.87	8,333.27
2065	38	1,708.25	4.87	8,324.85
2066	39	1,706.76	4.87	8,317.62
2067	40	1,705.37	4.87	8,310.85
2068	41	1,704.09	4.87	8,304.62
2069	42	142.05	4.87	692.26
2070			4.87	-
2071			4.87	-

Land Use Change

Forestland Variables Used in Land Use Change Calculations

Living Biomass

Variable	Value	Source
B_{Before} (tonnes BM/ha)	**86.31**	Canada's Forest Biomass Resources, NRCAN 1997 and the Forest Resources of Ontario, 2021
CF (tonne C/tonne dry matter)	**0.47**	IPCC 2006 - Vol. 4, Chp. 4, Table 4.3

Dead Organic Matter

Variable	Value	Source
Co (tonnes C/ha)	**66**	Carbon in Canada's Boreal Forest (Kurz et al., 2013)
DOM Carbon (tonnes C/ha)	**66**	Carbon in Canada's Boreal Forest (Kurz et al., 2013)

Soils

Soil Carbon Stock

Variable	Value	Source
▲C Inorganic (tonnes C/yr)	**0**	SACC Draft Technical Guidance: Annex B
SOCREF (t C/ha)	**23.1**	Carbon in Canada's Boreal Forest (Kurz et al., 2013)
FLU (dimensionless)	**0.8**	SACC Draft Technical Guidance: Annex B
FMG (dimensionless)	**1**	SACC Draft Technical Guidance: Annex B
FI (dimensionless)	**1**	SACC Draft Technical Guidance: Annex B
Peat Carbon (kg C/m^2)	**66**	Peat Deposits Store More Carbon than Trees in Forested Peatlands of the Boreal Biome (Beaulne et al. 2021)

Wetland Variables Used in Land Use Change Calculations

Living Biomass

Variable	Value	Source
B_{Before} (tonnes BM/ha)	**23.6**	Canada's Forest Biomass Resources, NRCAN 1997 and the Forest Resources of Ontario, 2021
CF (tonne C/tonne dry matter)	**0.47**	IPCC 2006 - Vol. 4, Chp. 4, Table 4.3

Aboveground Biomass Density

Wetland Type	Average Biomass (t/ha)	Source
Bog	**73**	Biomass and Carbon Pool of Two Bogs in the Experimental Lakes Area, Northwestern Ontario (Dick and Shay, 1999)
Fen	**5.65**	Net Primary Production And Standing Biomass In Northern Continental Wetlands (Campbel et al., 2000)
Marsh	**8**	Net Primary Production And Standing Biomass In Northern Continental Wetlands (Campbel et al., 2000)
Swamp	**40**	The unrecognized importance of carbon stocks and fluxes from swamps in Canada and the USA (Davidson et al., 2022)
Average	**23.6**	Weighted average by project land area

Soil Carbon Stock

Variable	Value	Source
▲C Inorganic (tonnes C/yr)	**0**	SACC Draft Technical Guidance: Annex B
SOCREF (t C/ha)	**129**	Carbon in Canada's Boreal Forest (Kurz et al., 2013)
FLU (dimensionless)	**0.8**	SACC Draft Technical Guidance: Annex B
FMG (dimensionless)	**1**	SACC Draft Technical Guidance: Annex B
FI (dimensionless)	**1**	SACC Draft Technical Guidance: Annex B
Peat Carbon (kg C/m^2)	**129**	Peat Deposits Store More Carbon than Trees in Forested Peatlands of the Boreal Biome (Beaulne et al. 2021)

Peat Carbon by Wetland Type

Wetland Type	Carbon Stock (kg C/m2)	Source
Bog	**158**	The Canadian model for peatlands (CaMP): A peatland carbon model for national greenhouse gas reporting (Bona et al., 2020)
Fen	**157**	
Swamp	**232**	
Marsh	**9**	A simple field method for estimating the mass of organic carbon stored in undisturbed wetland soils (Magnan et al., 2023)
Total	**129**	Weighted average by project land area

Crawford Nickel Project
Worksheet: **GWPs and EFs**

Global Warming Potentials (GWPs)

GHG	GWPs
CO_2	1
CH_4	28
N_2O	265
Source:	***Fifth Assessment Report, AR5.***

Emission Factors (EFs)

Category:	Mining Equipment and Vehicles		
Subcategory:	Off-road Diesel		
Fuel:	Diesel		
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	2,680.50	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Off-road Diesel > 19kW Tier 4*
CH_4	0.073	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Off-road Diesel > 19kW Tier 4*
N_2O	0.227	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Off-road Diesel > 19kW Tier 4*
kg CO_2e/unit energy	2,742.70	kgCO2e/kL	
kg CO_2e/unit energy	0.26	kgCO2e/kWh	Canada Energy Regulator Conversion Tables

Category:	Mining Equipment and Vehicles		
Subcategory:	LDGVs & LDGTs		
Fuel:	Gasoline		
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	2,307.30	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Light-duty Gasoline Vehicles (LDGVs) Tier 3 (Note. The same factors apply to Light-duty Gasoline Trucks (LDGTs))*
CH_4	0.111	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Light-duty Gasoline Vehicles (LDGVs) Tier 3 (Note. The same factors apply to Light-duty Gasoline Trucks (LDGTs))*
N_2O	0.007	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Light-duty Gasoline Vehicles (LDGVs) Tier 3 (Note. The same factors apply to Light-duty Gasoline Trucks (LDGTs))*

Category:	Locomotives		
Subcategory:	Downstream Transportation and Distribution		
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	0.021	kg/ton-mile	*USEPA, Emission Factors for Greenhouse gas Inventories, September 12, 2023. Table 8, Vehicler Type: Rail*
CH_4	0.0016	g/ton-mile	*USEPA, Emission Factors for Greenhouse gas Inventories, September 12, 2023. Table 8, Vehicler Type: Rail*
N_2O	0.0005	g/ton-mile	*USEPA, Emission Factors for Greenhouse gas Inventories, September 12, 2023. Table 8, Vehicler Type: Rail*

Category:	Blasting		
Subcategory:	n/a		
Fuel:	Emulsion		
Product	**EF Value**	**Units**	***Source/Reference***
Titan XL 1000	0.172	t CO_2e/t Product	*"emissions factors.docx" provided by Dave Penswick to Stantec, Decemebr 22, 2023*
Titan SME	0.172	t CO_2e/t Product	*"emissions factors.docx" provided by Dave Penswick to Stantec, Decemebr 22, 2023*
Dynosplit EX 32x26	0.311	t CO_2e/t Product	*"emissions factors.docx" provided by Dave Penswick to Stantec, Decemebr 22, 2023*
Trojan Spartan 450 g	1.187	t CO_2e/t Product	*"emissions factors.docx" provided by Dave Penswick to Stantec, Decemebr 22, 2023*

Category:	Construction Road Realignment		
Subcategory:	n/a		
Fuel:			
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	179.03	t CO_2e/km	*Infrastructure Carbon Estimator (ICE) 2.1.3. Final Tool. Released 03/24/2021, roadway realignment, rural minor arterioles, non-mountainous terrain*

Category:	Construction Rail Spur		
Subcategory:	n/a		
Fuel:			
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	789.14	t CO_2e/km	*Infrastructure Carbon Estimator (ICE) 2.1.3. Final Tool. Released 03/24/2021, heavy-rail construction, new construction (at grade) - track miles*

Crawford Nickel Project
Worksheet: **GWPs and EFs**

Category:	Transmission Line Construction		
Subcategory:	n/a		
Fuel:			
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	245.00	t CO_2e/km	https://www.researchgate.net/publication/350642224_Embodied_greenhouse_gas_emissions_from_building_China's_large-scale_power_transmission_infrastructure

Category:	Mining Equipment and Vehicles		
Subcategory:	Off-road Diesel		
Fuel:	Biodiesel		
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	2,472.20	kg/kL	*2023 NIR, Part 2, Table A6.1-14, Renewable Fuels, Biodiesel*
CH_4	0.037	kg/kL	*2023 EPA Emission Factors for Greenhouse Gas Inventories, Table 1: Stationary Combustion*
N_2O	0.003	kg/kL	*2023 EPA Emission Factors for Greenhouse Gas Inventories, Table 1: Stationary Combustion*
kf CO_2e/unit energy	2.474	kgCO2e/L	

Category:	Stationary Equipment		
Subcategory:	Energy Sources		
Fuel:	Natural Gas		
GHG	**EF Value**	**Units**	***Source/Reference***
CO_2	1,921.00	g/m3	*2023 NIR, Part 2, Table A6.1-1, CO2 Emission Factors for Marketable Natural Gas, ON*
CH_4	0.037	g/m3	*2023 NIR, Part 2, Table A6.1-3, CH4 and N2O Emissions for Natural Gas*
N_2O	0.035	g/m3	*2023 NIR, Part 2, Table A6.1-3, CH4 and N2O Emissions for Natural Gas*
kg CO_2e/unit energy	1.931	kgCO2e/kL	
kg CO_2e/unit energy	0.19	kgCO2e/kWh	Canada Energy Regulator Conversion Tables